

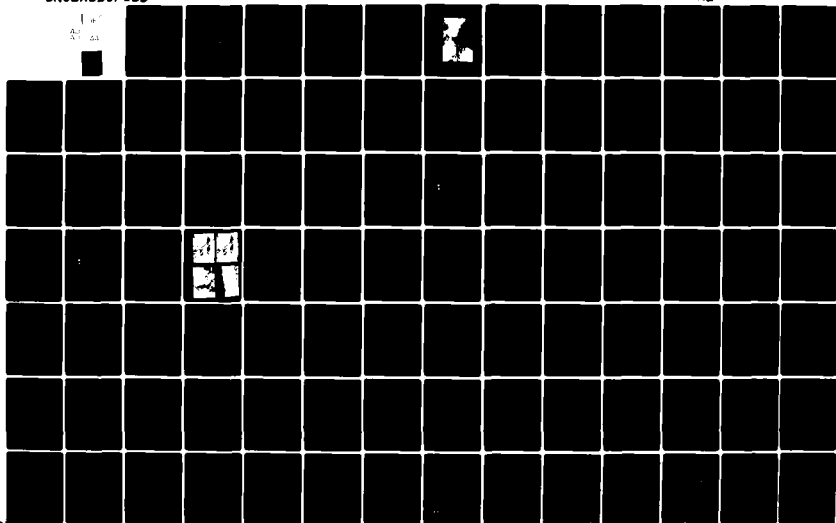
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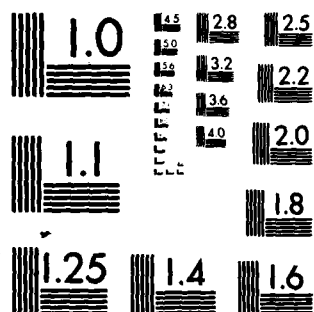
KIMBALL (L ROBERT) AND ASSOCIATES EBENSBURG PA
NATIONAL DAM INSPECTION PROGRAM. LAKE LOUISE DAM (NDS ID NUMBER--ETC(U)
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NATIONAL BUREAU OF STANDARDS-1963-A

AD A091448

SUSQUEHANNA RIVER BASIN
SUTTONS CREEK, LUZERNE COUNTY

PENNSYLVANIA

LAKE LOUISE DAM

(NDS ID ~~PA~~ PA-558,
DER ID ~~40~~ 40-134)
Number

~~LAKE LOUISE ESTATES~~

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM



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COLLECTED
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Prepared By

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA

15931

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FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND

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SEPTEMBER 1980

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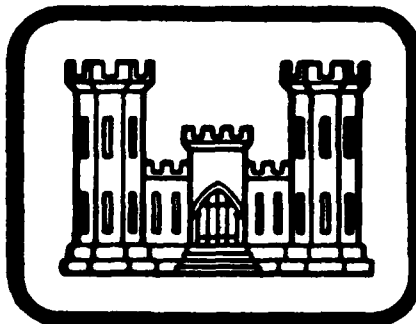
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SUSQUEHANNA RIVER BASIN
SUTTONS CREEK, LUZERNE COUNTY

PENNSYLVANIA
LAKE LOUISE DAM

NDS ID NO. PA-558
DER ID NO. 40-134

LAKE LOUISE ESTATES
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



Prepared By
L. ROBERT KIMBALL & ASSOCIATES
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EBENSBURG, PENNSYLVANIA
15931

FOR
DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

SEPTEMBER, 1980

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Lake Louise Dam
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Luzerne
STREAM	Sutton Creek
COORDINATES	Lat: 41° 22.9' Long: 75° 54.6'
DATES OF INSPECTION	May 21, 1980 and July 30, 1980

ASSESSMENT

The assessment of Lake Louise Dam is based upon visual observations made at the time of inspection, review of available data, and hydraulic and hydrologic analysis.

↙ Lake Louise Dam appears to be in poor condition. Lake Louise Dam is a high hazard small size dam. The spillway design flood is in the range of 1/2 PMF to PMF. The spillway design flood was selected to be the PMF (probable maximum flood) based on downstream potential for loss of life and property damage. The spillway is capable of controlling approximately 45% of the PMF. The dam breach analysis indicated that a significant increase in the downstream potential for loss of life and property damage exists should the dam fail. Based on criteria established by the Corps of Engineers, the spillway is termed seriously inadequate. The spillway exit and entrance channels are in poor condition. The heavy vegetation creates the potential for water infiltration and made visual inspection of the embankment difficult. Lake Louise Dam is classified as an unsafe non-emergency dam. ↘

The following recommendations and remedial measures should be instituted immediately.

1. A detailed hydrologic and hydraulic analysis should be conducted by a registered professional engineer knowledgeable in dam design and construction to increase the spillway capacity of the dam. Recommendations resulting from this study should be implemented immediately.

The spillway discharge channel and outlet is in a deteriorating condition. The outlet is being undercut by spillway discharges and subsequent cracking of the concrete channel is occurring. The spillway should be evaluated during the hydrologic and hydraulic analysis and repairs made as required. The spillway entrance is obstructed by a wire fence and trapped debris and vegetation. These obstructions should be removed immediately.



Overview of Lake Louise

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PHASE I
NATIONAL DAM INSPECTION PROGRAM
LAKE LOUISE DAM
NDI. I.D. NO. PA 558
DER I.D. NO. 40-134

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Lake Louise Dam is an earthfill dam with a bituminous paved road and guard rails for the entire length. The dam is 16 feet high and 210 feet long. The crest width is 26 feet. The upstream slope was measured to be 1.5H:1V with heavy brush and trees. The downstream slope was measured to be 1.5H:1V with heavy brush and trees. The reservoir drain consists of a 16" cast iron pipe encased in concrete. The reservoir drain is controlled by a cast iron gate valve located at the downstream outlet of the structure. The spillway is a weir type spillway consisting of two 14 foot sections passing under a highway bridge. The exit channel is protected with dry rubble wingwalls and a concrete slab. The dam has a concrete corewall which extends from elevation 1078 to approximately 1102.

b. Location. The dam is located on Sutton Creek, Luzerne County, Pennsylvania. Lake Louise Dam can be located on the Center Moreland, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. Lake Louise Dam is a small size structure (16 feet high, 705 acre-feet).

d. Hazard Classification. The hazard classification for Lake Louise Dam has been determined to be high. Downstream conditions at the time of inspection indicated that the loss of more than a few lives is probable should the structure fail. One home is located approximately 1/2 mile downstream of the dam and several homes exist within 1.5 miles downstream of the dam.

e. Ownership. Lake Louise Dam is owned by Lake Louise Estates. Correspondence should be addressed to:

Lake Louise Estates
So Climate Equipment Company
Woodward Hill Road
Alva, Iselle, Pennsylvania
610-237-2129

f. Purpose of Dam. Lake Louise Dam was originally established for recreation but more recently it is used for real estate development.

g. Design and Construction History. Construction of Lake Louise Dam was completed in 1927. According to information located in DER files, the dam was constructed by the Luzerne County Construction Company, under the supervision of Fred C. Wintermute, a professional engineer from Wilkes-Barre, Pennsylvania. No construction testing was available for our review, however, construction inspection reports indicated that construction proceeded satisfactorily. There was some information in the DER files which suggests that construction did not conform entirely to the original construction plans. However, this matter was resolved based on correspondence located in the DER files.

h. Normal Operating Procedures. A representative of the owner was available for interview at the time of inspection. It was determined that Lake Louise Estates, the present owner, obtained control of the dam in 1974. It was also determined that there are no scheduled operating procedures or maintenance schedule for the dam. The gate valve controlling the reservoir drain has not been opened in at least 5 years. The only maintenance that is done at the dam is provided by the state, in their efforts to maintain the roadway and the bridge.

1.3 Pertinent Data.

a. Drainage Area.

2.69 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	6" above present waterlevel (approximately 50)
Drainage capacity at normal pool	Unknown
Spillway capacity at top of dam	2039

c. Elevation (U.S.G.S. Datum) (feet). - Based on assumed pool elevation of 1093. Estimated from U.S.G.S. 7.5 minute quadrangle.

Top of dam - low point	1101.0
Top of dam - design height	Unknown
Maximum pool - design surcharge	Unknown
Normal pool	1093.0
Spillway crest	1093.0
Upstream invert - 16" drainline	Unknown
Downstream invert - 16" drainline	Unknown
Maximum tailwater	1085.1
Toe of dam	1085.1

d. Reservoir (feet).

Length of maximum pool	5300 feet
Length of normal pool	4000 feet

e. Storage (acre-feet).

Normal pool	193
Top of dam	705

f. Reservoir Surface (acres).

Top of dam	83
Normal pool	56
Spillway crest	56

g. Dam.

Type	Earthfill
Length	210
Height	16 feet
Top width	26 feet
Side slopes - upstream	1.5H: 1V
- downstream	1.5H: 1V
Zoning	No
Impervious core	Concrete corewall
Cutoff	Concrete cutoff
Grout curtain	No

h. Reservoir Drain.

Type	16" cast iron pipe
Length	100 feet

Closure
Access
Regulating facilities

16" gate valve
Valve box downstream toe
16" gate valve

1. Spillway.

Type

Concrete weir
in channel
under bridge
Two 14 foot sections
1093.0
Lake
Concrete channel

Length
Crest elevation
Upstream channel
Downstream channel

SECTION 2 ENGINEERING DATA

2.1 Design. Correspondence and permit information was available for review in the PennDER files. Some construction drawings were also available but these drawings did appear to indicate as-built conditions. No additional information was provided by the owner.

2.2 Construction. Some information was available in the PennDER files on the construction of the dam. One inspection report prepared by Fred C. Wintermute stated that construction was progressing satisfactorily. One correspondence report between Mr. Wintermute and the Department of Forest and Waters, explains that as-built conditions do not represent the design. The as-built conditions were presented to the Department of Forest and Waters and approved by them. These drawings do not exist in the current DER file.

2.3 Operation. No operating records are known to exist. The state maintains the bridge and roadway over the dam.

2.4 Evaluation.

a. Availability. Engineering data were provided by PennDER, Bureau of Dams and Waterways Management. A representative of the owner provided information on recent history and maintenance of the structure during the inspection.

b. Adequacy. Minimal design data was available for review for the purpose of this report. Limited information was available for review concerning the construction of the dam. No as-built drawings exist in the DER files. This Phase I Report is based on available data, visual inspection, hydrologic and hydraulic analysis. Sufficient information exists to complete a Phase I Report.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The on site inspection of Lake Louise Dam was conducted by personnel of L. Robert Kimball and Associates on May 21, 1980 and July 30, 1980. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appears to be in poor condition. From a brief survey conducted during the inspection, it was noted that the main embankment crest has a low spot midway across the embankment. The crest of the embankment is a paved state maintained roadway. The upstream and downstream slopes are covered with heavy brush and trees. At least one large tree had fallen creating a depression, slope over steepening and a location for infiltration and potential stability problems. No seepage was noted on the embankment or at the toe, however several wet spots exist beyond the toe. Erosion was noted along the right abutment contact resulting from roadway drainage.

An active slide, in natural ground, is present on the left abutment near the spillway exit channel. This slide has moved soil material into the exit channel and several large trees have fallen into the exit channel.

c. Appurtenant Structures. The waterlevel at the time of the inspections was estimated to be at elevation 1093.0. The spillway approach and exit channels are in poor condition. The spillway entrance channel is blocked by vegetation debris and a deteriorating fence (fish screen) across the spillway catches debris and increases blockage. The concrete exit channel is extensively cracked due to undercutting at the toe of the concrete. If this condition is allowed to continue it could lead to possible deterioration in the entire exit channel and could cause stability problems of the wingwalls and ultimate spillway failure. The wingwalls consist of masonry rubble and currently show movement and separation. The drainline for the reservoir consists of a 16" cast iron pipe encased in concrete. The drain is controlled by a 16" gate valve which has not been operated in at least 5 years. The overall condition of the

drainline is unknown. The intake and discharge structures were unobserved during the inspection. The valve chamber at the toe of the dam was observed during the inspection. No upstream shut-off is provided in the drainline.

d. Reservoir Area. The watershed is covered mostly with timber. The reservoir slopes are gentle to moderate and do not appear to be susceptible to massive landslides which would affect the storage volume of the reservoir or cause overtopping of the dam by displacing water.

e. Downstream Channel. The downstream channel of Lake Louise Dam is Sutton Creek a relatively narrow creek. The dam is about four miles from the North Branch of the Susquehanna River.

3.2 Evaluation. In general, the embankment, spillway structure and outlet works appear in poor condition.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The water level is maintained at the spillway crest elevation of 1093.0. A representative of the owner indicated that there is no maintenance schedule or operational procedures.

4.2 Maintenance of the Dam. No planned maintenance schedule for the dam exists other than the maintenance of the roadway by state maintenance crews.

4.3 Maintenance of Operating Facilities. Operating facilities for the dam have not been maintained or operated in at least 5 years. The condition of these facilities are unknown.

4.4 Warning System in Effect. There is no known warning system in effect to warn downstream residents or property owners of large spillway discharges or imminent failure of the dam. At the time of inspection there were several downstream residences.

4.5 Evaluation. The condition of the operating facilities is unknown and no maintenance procedures exists. There is no warning system to warn downstream residents.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. The PennDER files contained only minimal hydrologic and hydraulic design information. There are some hand written calculations in the files, however these do not seem to be part of the design criteria. Information in the files suggested that the spillway design dealt with bridge stability rather than hydrologic or hydraulic considerations.

b. Experience Data. No rainfall or runoff data were available. It was indicated that the maximum known reservoir level obtained was 6" above the normal pool level. The spillway reportedly has functioned adequately in the past.

c. Visual Observations. The spillway approach and discharge channels are in poor condition. The upstream channel is blocked by vegetation and debris while the downstream channel has extensive deterioration due to undercutting of concrete at the toe. A fence (fish screen) across the spillway crest traps debris and will cause further blockage.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D.

5.2 Evaluation Assumptions. To enable us to complete the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. Pool elevation prior to the storm was at the spillway crest elevation of 1093.0.

2. Cummings Pond a natural upstream pond exists and was considered capable of storing some of the inflow. Lake Manjo a small man made upstream pond was ignored in this analysis.

3. Top of the dam was considered to be at the low spot elevation of 1101.0 feet.

4. Blockage of the spillway was not taken into account.

5.3 Summary of Overtopping Analysis. Complete summary sheets for the computer output are presented in Appendix D.

Peak inflow (PMF)	7340 cfs
Spillway capacity	2039 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) for a dam of this size and classification is in the range of 1/2 PMF to PMF. The SDF is based on the hazard and size classification of the dam. Based on the hazard potential for this dam the spillway design flood (SDF) was selected to be the PMF. Based on the following definition provided by the Corps of Engineers, the spillway is rated as seriously inadequate as a result of our hydrologic analysis.

Seriously inadequate - High hazard classification dams not capable of passing 50% of the spillway design flood and where there is a significant increase in the downstream hazard potential for loss of life due to overtopping failure.

The spillway and reservoir are capable of controlling approximately 45% of the PMF without overtopping the embankment at the low spot. Because of the blockage of the spillway entrance the spillway capacity could be further reduced.

5.4 Summary of Dam Breach Analysis. The subject dam cannot satisfactorily pass 50% of the PMF based on our analysis therefore it was necessary to perform the dam breach analysis and downstream routing of the flood wave. This analysis determined the degree of increased flooding due to dam failure.

The 1/2 PMF storm overtops the low spot on the dam crest by 1.10 feet for a duration of 2.25 hours. A reservoir pool elevation of 1102 was considered sufficient to cause failure of the Lake Louise Dam. This elevation represents a depth of overtopping of approximately 1 foot over the low spot of the dam and approximately 1.3 inches over the critical left abutment area.

The resulting flood wave was routed downstream with and without failure considerations. Downstream potential for loss of life and property damage is significantly increased by dam failure. Therefore the spillway is rated as seriously inadequate. A detailed printout of the breach analysis is included in Appendix D.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Visual observations indicated a slide in natural ground near the left abutment and erosion along the downstream toe near the right abutment. The spillway wingwalls which consist on masonry rubble show signs of deterioration.

The stability of the dam is of concern because of the fairly steep slopes and the dense vegetation. At least one large tree has fallen creating the potential for water infiltration and potential stability problems. There is no indication that a stability analysis had been performed in the past. The vegetation on the slope should be removed in a controlled manner. After removal, a detailed visual inspection should be conducted by a registered professional engineer knowledgeable in dam design and construction to determine whether a stability analysis of the structure should be conducted.

b. Design and Construction Data. No stability analysis was conducted for this dam. No as-built drawings were available for review by the inspection team and limited construction data is available.

c. Operating Records. No operating records are maintained.

d. Post Construction Changes. There were no indications of any post construction changes in the DER files. There were no as-built drawings available for review.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analysis has been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading. No visual deficiencies were observed during the inspection. There exist no known stability analysis to document the stability of the dam.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. Lake Louise Dam was heavily vegetated making the inspection difficult. The dam appeared to be in poor condition. A small slide was observed near the left abutment in natural ground adjacent to the spillway wingwall. Erosion was observed along the downstream toe of the embankment. Both slopes are covered with heavy brush and trees and at least one large tree had fallen. Falling trees could lead to infiltration and could cause potential instability.

Visual observations, and hydrologic and hydraulic calculations indicated that Lake Louise Dam's spillway is seriously inadequate. The spillway is capable of controlling approximately 45% of the PMF without overtopping the embankment at the low spot. The dam breach analysis indicated that a significant increase in the downstream potential for loss of life and property damage exists should the dam fail. Lake Louise Dam is classified as an unsafe non-emergency dam.

b. Adequacy of Information. This Phase I Report is based on visual observations, hydrologic and hydraulic calculations and interviews with the owners. Inspection and evaluation of the embankment was difficult due to trees and brush located on the slopes and toe.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigation. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required. Inspection of the dam was difficult due to the heavy vegetation. A more in-depth evaluation should be made once the vegetation is removed.

7.2 Recommendations/Remedial Measures.

1. A detailed hydrologic and hydraulic analysis should be conducted by a registered professional engineer knowledgeable in dam design and construction to increase the spillway capacity of the dam. Recommendations resulting from this study should be implemented immediately.

The spillway discharge channel and outlet is in a deteriorating condition. The outlet is being undercut by spillway discharges and subsequent cracking of the concrete channel is occurring. The spillway should be evaluated during the hydrolo-

gic and hydraulic analysis and repairs made as required. The spillway entrance is obstructed by a wire fence and trapped debris and vegetation. These obstructions should be removed immediately.

2. The trees and heavy vegetation on the slopes should be removed at the direction of a registered professional engineer knowledgeable in dam design and construction. After the vegetation is removed a detailed visual inspection should be made to determine whether a stability analysis is warranted.

3. Erosion along the toe near the right abutment should be repaired and measures should be taken to prevent future erosion.

4. Some means of positive upstream closure of the drainline should be developed.

5. A warning system should be developed to warn any downstream residents of large spillway discharges or imminent failure of the dam.

6. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Lake Louise Dam COUNTY Luzerne STATE Pennsylvania ID# PA 558
TYPE OF DAM Earthfill HAZARD CATEGORY High
DATE(s) INSPECTION May 21, 1980
July 30, 1980 WEATHER Seasonal TEMPERATURE Seasonal

POOL ELEVATION AT TIME OF INSPECTION 1093.0 M.S.L. TAILWATER AT TIME OF INSPECTION M.S.L.

A-1

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates
James T. Hockensmith - L. Robert Kimball and Associates
O.T. McConnell - L. Robert Kimball and Associates
Cameron R. Mock - L. Robert Kimball and Associates

James T. Hockensmith RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Small slide near the left abutment.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Erosion along the downstream toe. Minor erosion near bridge - see A-12.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment appears to be good. Low spot on the embankment crest approximately 200 feet from the left abutment.	
RIPRAP FAILURES	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Heavy brush and trees on both slopes.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Spillway in a deteriorating condition - See A-12.	
ANY NOTICEABLE SEEPAGE	None.	
STAFF GAUGE AND RECORDER	None.	
DRAINS	None.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Not applicable.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not applicable.	
DRAINS	Not applicable.	
WATER PASSAGES	Not applicable.	
FOUNDATION	Not applicable.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not applicable.	
STRUCTURAL CRACKING	Not applicable.	
VERTICAL AND HORIZONTAL ALIGNMENT	Not applicable.	
MONOLITH JOINTS	Not applicable.	
CONSTRUCTION JOINTS	Not applicable.	
STAFF GAUGE OR RECORDER	Not applicable.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Exit channel concrete is cracking due to undercutting erosion.	
INTAKE STRUCTURE	Blocked by debris.	
OUTLET STRUCTURE	Cracking due to erosion and undercutting.	
OUTLET CHANNEL	Natural streambed.	
EMERGENCY GATE	None.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Appears to be good condition. Although exit channels and entrance channels need some work.	
APPROACH CHANNEL	Blocked by debris.	
DISCHARGE CHANNEL	Creek. Exit channel has some erosion and undercutting.	
BRIDGE AND PIERS	Appear to be in good condition. Although minor erosion exists near the abutments.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	None.	
APPROACH CHANNEL	None.	
DISCHARGE CHANNEL	None.	
BRIDGE AND PIERS	None.	
GATES AND OPERATION EQUIPMENT	None.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Erosion near the toe of slopes. Slide exists on the left abutment in natural ground adjacent to spillway.	
SLOPES	Appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	One home - 4 people - approximately 1/2 mile downstream. Several homes - 10 people - exist within 1 1/2 mile downstream of the dam.	

RESERVOIR

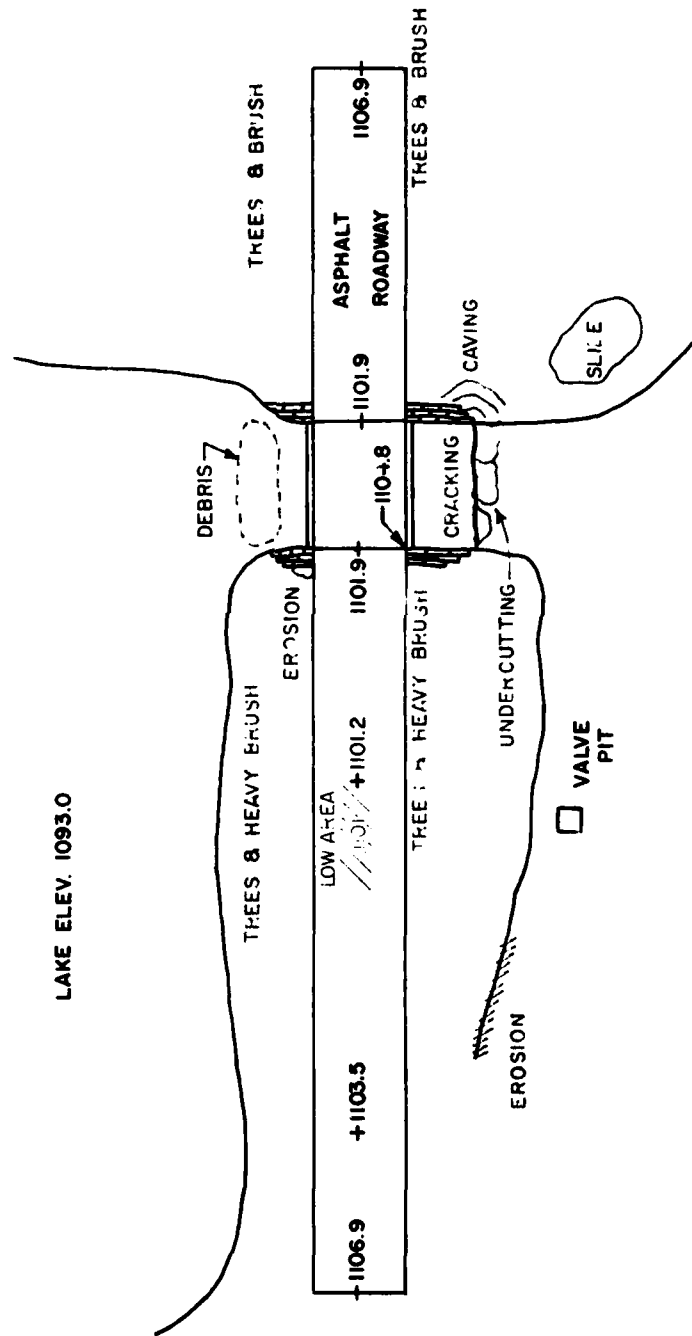
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderate. Appear to be stable.	
SEDIMENTATION	Unknown.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

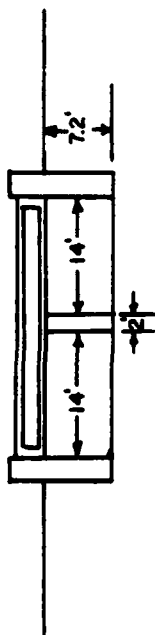


LAKE ELEV. 1093.0

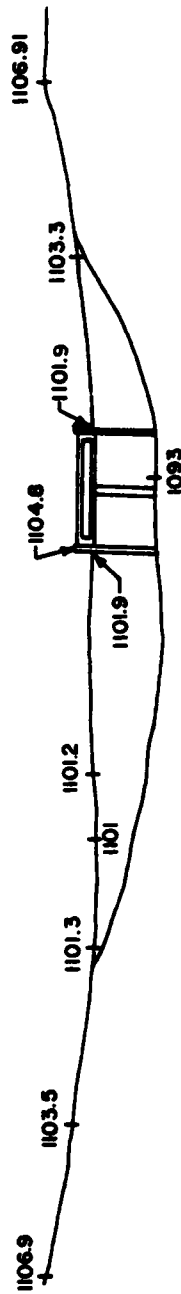


LAKE LOUISE DAM

Scale: 1" = 50'



SPILLWAY SECTION
(Not To Scale)



PROFILE
LOOKING UPSTREAM

Scale: Horiz. 1" = 50'
Vert. 1" = 20'

LAKE LOUISE DAM



APPENDIX B
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION,
PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Lake Louise Dam
 ID# 558

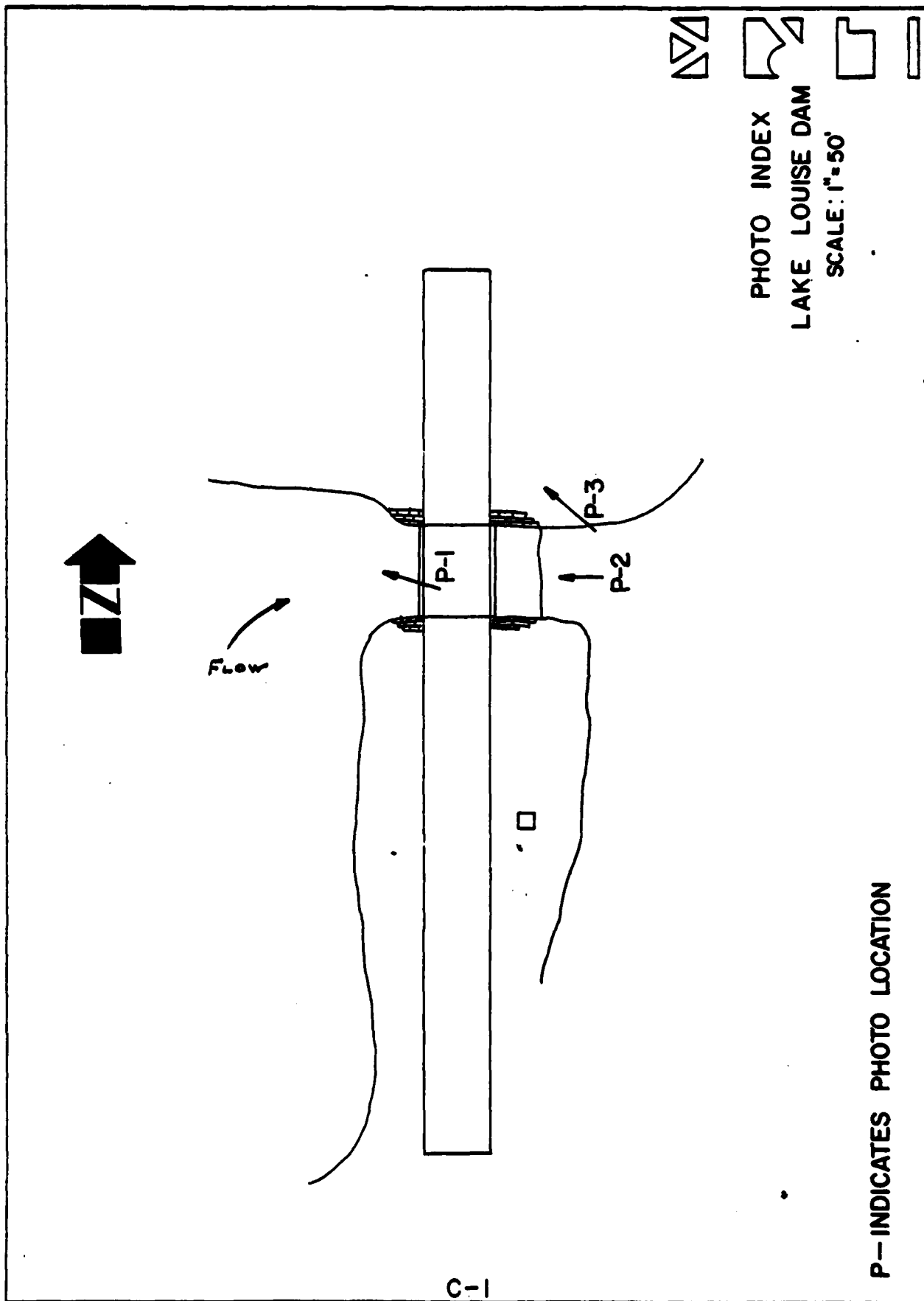
ITEM	REMARKS
AS-BUILT DRAWINGS	None. Although some original construction plans do exist.
REGIONAL VICINITY MAP	U.S.G.S. 7.5 minute quadrangle.
CONSTRUCTION HISTORY	DER files.
TYPICAL SECTIONS OF DAM	None.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	None. None. None. None. None.

ITEM	REMARKS
DESIGN REPORTS	Construction inspection report explains as-built conditions and reasons for them.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Some limited calculations which do not appear to be significant as far as design.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None.
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Unknown.
HIGH POOL RECORDS	6" over normal pool level.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Unknown.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None.
MAINTENANCE OPERATION RECORDS	None, although state maintains a road over the dam.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	None.
OPERATING EQUIPMENT PLANS & DETAILS	None.

APPENDIX C
PHOTOGRAPHS



P- INDICATES PHOTO LOCATION

LAKE LOUISE DAM
PA 558

Photograph Descriptions

Sheet 1

Front

- (1) Upper left - Spillway approach and debris in entrance channel.
- (2) Upper right - Culvert spillway and downstream culvert channel. Note cracking of concrete and undercutting.
- (3) Lower left - Slide on downstream slope on left abutment.
- (4) Lower right - Downstream exposure

TOP OF PAGE

1	2
3	4



APPENDIX D
HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Investigation), September, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 40" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topographic
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

HYDROLOGY AND HYDRAULICS ANALYSIS DATA BASE

NAME OF DAM: Lake Louise Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.2 (.97) - 21.53 inches

STATION	1	2	3	4
Station Description	Cummings Pond	Subarea 2	Subarea 3	Subarea 4
Drainage Area (square miles)	.44	.57	.40	1.28
Cumulative Drainage Area (square miles)	.44	1.01	1.41	2.69
Adjustment of PMF for Drainage Area (%) ⁽¹⁾				
6 hours	117	117	117	117
12 hours	127	127	127	127
24 hours	136	136	136	136
48 hours	142	142	142	142
72 hours	145	145	145	145
Snyder Hydrograph Parameters				
Zone ⁽²⁾	11	11	11	11
C _p ⁽³⁾	.62	.62	.62	.62
C _t ⁽³⁾	1.50	1.50	1.50	1.50
L (miles) ⁽⁴⁾	.76	1.17	1.37	1.94
L _{ca} (miles) ⁽⁴⁾	.15	.62	.80	1.09
t _p = C _t (LxL _{ca}) 0.3 hrs.	.78	1.36	1.54	1.88

Spillway Data
Crest Length (ft)
Freeboard (ft)
Discharge Coefficient
Exponent

- (1) Hydrometeorological Report 40 (Figure 1), U.S. Army Corps of Engineers, 1965.
- (2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C_p and C_t).
- (3) Snyder's Coefficients.
- (4) L=Length of longest water course from outlet to basin divide.
L_{ca}=Length of water course from outlet to point opposite the centroid of drainage area.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: D.A. 2.69 mi² wooded, gentle slopes
ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 193 ac-ft
ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 705 ac-ft
ELEVATION MAXIMUM DESIGN POOL: Unknown
ELEVATION TOP DAM: 1101

SPILLWAY CREST:

a. Elevation 1093
b. Type Concrete weir in channel
c. Width 28
d. Length N/A
e. Location Spillover 60' from left abutment
f. Number and Type of Gates

OUTLET WORKS:

a. Type 16" cast iron pipe encased in concrete
b. Location 160' from left abutment
c. Entrance inverts Unknown
d. Exit inverts Unknown
e. Emergency draindown facilities 16" gate valve

HYDROMETEOROLOGICAL GAUGES:

a. Type Unknown
b. Location Unknown
c. Records Unknown

MAXIMUM NON-DAMAGING DISCHARGE: Unknown



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CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME LAKE LOUSE

I.D. NUMBER 558

SHEET NO. 1 OF 8

BY CAB DATE 7-9-85

LOSS RATE AND BASE FLOW PARAMETERS

AS RECOMMENDED BY CORPS OF ENGINEERS
BALTIMORE DISTRICT.

STRTL = 1 INCH

CNSTL = .05 IN/HR

STRTO = 1.5 CFS/MI²

RTIOR = 2.0

QRCSN = .05 (5% OF PEAK FLOW)

ELEVATION- AREA- CAPACITY RELATIONSHIPS

FROM U.S.G.S. 7.5 MIN. QUAD., DER FILES, AND
FIELD INSPECTION DATA.

CUMMINGS POND

CREST ELEV = 1191

POND SURFACE AREA = 39 AC

ZERO STORAGE ELEV = 1185

AREA AT ELEV. 1185 = 4.5 AC

AREA AT ELEV. 1200 = 82 AC

FROM THE CONIC METHOD OF RESERVOIR VOLUME

$$\Delta V = \frac{\Delta}{3} (A_1 + A_2 + \sqrt{A_1 A_2})$$

STORAGE AT ELEV 1191 = 113 AC FT

STORAGE AT ELEV 1200 = 916 AC FT



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DAM NAME LAKE LOUISE

I.D. NUMBER 556

SHEET NO. 2 OF 2

BY CAB DATE 7-9-80

\$S	0	113	310	913
\$E	1185	1191	1195	1200

LAKE LOUISE

CREST ELEV. = 1093
POND SURFACE AREA = 56 AC.
ZERO STORAGE ELEV. = 1085
AREA AT ELEV 1100 = 80 AC
AREA AT ELEV 1120 = 159 AC
AREA AT ELEV 1090 = 35 AC

FROM U.S.G.S.
7.5-MIN QUND
AND INSPECTION
DATA

FROM THE CONIC METHOD OF RESERVOIR STORAGE

$$\Delta V = \frac{1}{3} (A_1 + A_2 + \sqrt{A_1 A_2})$$

STORAGE TO ELEV. 1090 = 58 AC-FT
STORAGE TO ELEV. 1093 = 193 AC-FT
STORAGE TO ELEV. 1100 = 666 AC-FT
STORAGE TO ELEV. 1120 = 3011 AC-FT

\$S	0	58	193	666	705	850
\$E	1085	1090	1093	1100	1101	1105



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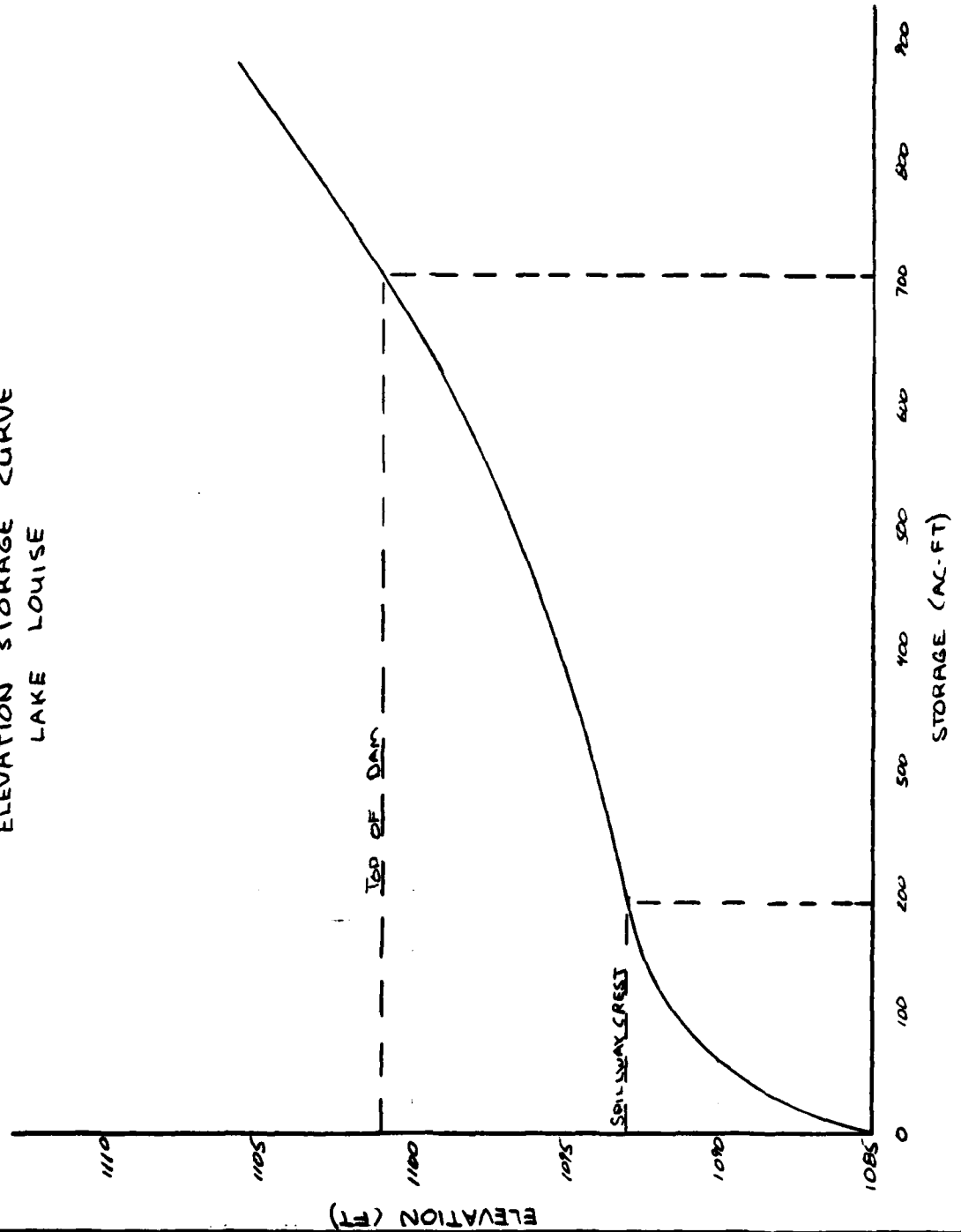
DAM NAME LAKE LOUISE

I.D. NUMBER 558

SHEET NO. 3 OF 8

BY CAB DATE 7-9-90

ELEVATION STORAGE CURVE
LAKE LOUISE





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DAM NAME LAKE LOUISE

I.D. NUMBER SSB

SHEET NO. 4 OF 5

BY CAL DATE 7-9-80

OVERTOP PARAMETERS

CUMMINGS POND

THE NATURAL POND WILL BE CONSIDERED
A DAM FOR THIS ANALYSIS

CREST ELEV = 1191

LENGTH OF DAM (EXCLUDING SPILLWAY) = 10'

TOP OF DAM ELEV. = 1193

COEFFICIENT OF DISCHARGE = 3.0

SL	10	587	1350	1190
SV	1193	1200	1210	1220

LAKE LOUISE

CREST ELEV = 1093

LENGTH OF DAM (EXCLUDING SPILLWAY) = 95'

TOP OF DAM ELEV. = 1101

COEFFICIENT OF DISCHARGE = 3.0

SL	5	35	75	105	135	190
SV	1101	1101.2	1101.5	1101.8	1102	1103

233	260	285
1104	1105	1106



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NAME LEE LOUISE

NUMBER 555

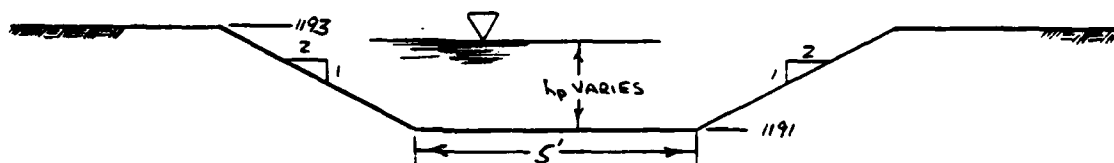
SHEET NO. 5 OF 8

BY CAB DATE 7-9-80

SPILLWAY RATING CURVE

CUMMINGS POND

TRAPEZOIDAL SPILLWAY
(NOT TO SCALE)



ELEV (FT)	TRAPEZOIDAL		WEIR		Q* TOTAL (CFS)
	h _p (FT)	Q* (CFS)	h _p (FT)	Q* (CFS)	
1191	0	0			0
1192	1	20			20
1193	2	65			65
1194			1	40	105
1195			2	115	180
1197			4	320	385
1200			7	745	810

* VALUES ROUNDED TO NEAREST SCFS

TRAPEZOIDAL FLOW FROM:

$$Q = 8.03 C' h_v^{3/2} (h_p - h_v) [B + Z(h_p - h_v)]$$

$$h_v = \frac{3(2Z h_p + B)}{10Z} - \left(\frac{16Z^2 h_p^2 + 16Z B h_p + 9B^2}{10Z} \right)^{1/2}$$

$$B = 5' \quad Z = 2' \quad C' = .95$$



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NAME LAKE LOUISE

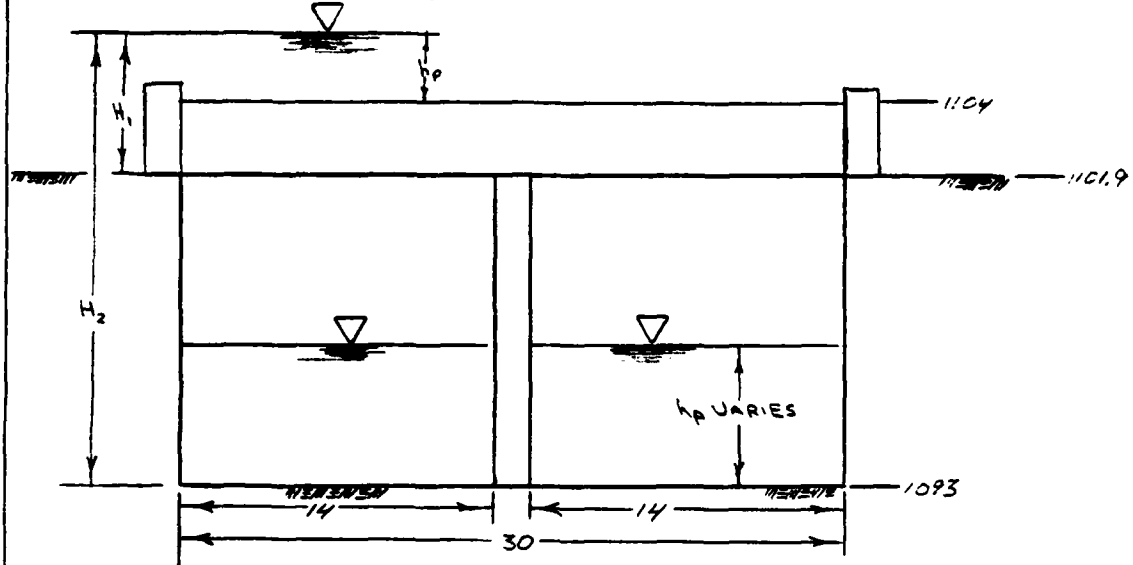
NUMBER SCF

SHEET NO. 6 OF 8

BY CAZ DATE 7-2-50

LAKE LOUISE

SPILLWAY NOT TO SCALE



ELEV (FT)	WEIR		ORIFICE		Q* TOTAL (CFS)
	h ₀ (FT)	Q* (CFS)	H ₁ (FT)	Q* (CFS)	
1093	0	0			0
1095	2	250			250
1098	5	1000			1000
1100	7	1660			1660
1101.9	8.9	2380			2380
1103			1.1	2740	2740
1104			2.1	3010	3010
1105	1.0	90	3.1	3250	3340
1107	3.0	500	5.1	3680	4180
1110	6.0	1410	8.1	4235	5645

* VALUES ROUNDED TO NEAREST 5 CFS



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EDENSBURG PENNSYLVANIA

NAME Lake Louise

NUMBER 55B

SHEET NO. 7 OF 5

BY CA3 DATE 7-5-80

WEIR FLOW FROM:

$$Q = C L h_p^{1.5}$$

FOR CUMMINGS POND

$$C = 5.1 \quad L = 13$$

FOR LAKE LOUISE

$$C = 3.2 \quad L = 28, 30$$

NOTE:

30' TOTAL LENGTH.

28' EFFECTIVE LENGTH.

ORIFICE FLOW FROM:

$$Q = \frac{2}{3} C \sqrt{2g} L (H_2^{3/2} - H_1^{3/2})$$

$$C = .6 \quad g = 32.2 \quad L = 28$$

SOURCE: WATER AND WASTEWATER ENGINEERING
by: FAIR Geyer, ORUM 1966

LOW DAMS by: NATIONAL RESOURCES
COMMITTEE, WASHINGTON DC.

HANDBOOK OF APPLIED HYDRAULICS
by: DAVIS, SORENSEN

CHANNEL ROUTING

CROSS SECTIONS OBTAINED FROM U.S.G.S 7.5
MIN. QUAD.

CHANNEL MANNINGS' $n = .05$

OVERBAUK MANNINGS' $n = .06$



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DAM NAME LAKE LOUISE

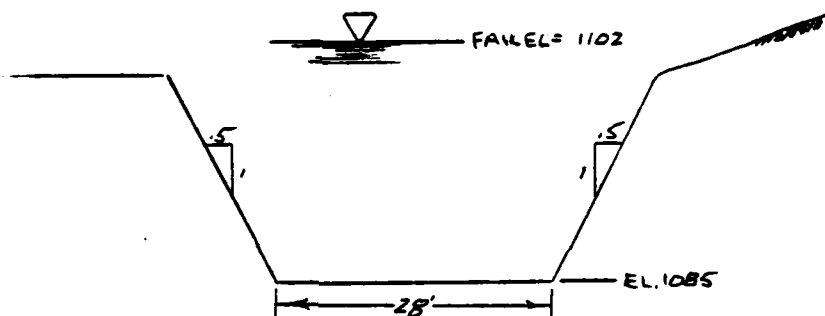
I.D. NUMBER SSB

SHEET NO. 8 OF 8

BY SAB DATE 7-9-80

DAM BREACH PARAMETERS

ASSUME THE DAM FAILS NEAR THE LEFT ABUTMENT DUE TO OVERTOPPING AND EROSION OF THE DAMAGED AREA. IT IS BELIEVED THAT THE ASPHALT ROAD SURFACE WILL NOT SUPPLY SUFFICIENT PROTECTION AGAINST UNDERCUTTING AND EVENTUAL FAILURE.



PMF RATIO = .5

TIME OF FAILURE (T_{FAIL}) = 2.0 HR.

FAILURE ELEV. ($FAILEL$) = 1102

SIDE SLOPES (Z) = .5

BREACH BOTTOM WIDTH (EL_{BM}) = 28'

[illegible]

46	P	21.53	117	127	136	142	145	.05
47	T							
48	W	1.54	.62					
49	X	-1.5	-0.05	2.0				
50	K	0	7					
51	K1	INFLOW FROM SUBAREA NO. 4						
52	M	1	1.28					
53	P	21.53	117	127	136	142	145	.05
54	B							
55	W	1.66	.62					
56	X	-1.5	-0.05	2.0				
57	K	0	8					
58	K1	COMBINING THREE HYDROGRAPHS						
59	Z	1	9					
60	K1	ROUTE THROUGH LAKE LOUISE						
61	Y							
62	V1	1						
63	V4	1093	1095	1098	1100	1101.9	1103	1107
64	V5	0	250	1000	1660	2380	2740	3340
65	V6	0	58	193	666	705	850	944
66	SE	1085	1090	1093	1100	1103	1105	
67	SS	1093						
68	SO	1101	1101.2	1101.5	1101.8	1102	1103	1104
69	SL	5	75	105	132	190	233	285
70	SV	1101	1101.2	1101.5	1101.8	1102	1103	1104
71	K	99						

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

RUN DATE= 80/07/16.
TIME= 14.22.45.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF THE PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAKE LOUISE DAM
RATIOS OF THE PMF ROUTED THROUGH THE RESERVOIR (559)

JOB SPECIFICATION

NO	NHR	MIN	IDAY	IHR	IMIN	METC	IPLT	IPRT	ASTAN
288	0	15	0	0	0	0	0	0	0
	JOPER	5		NWT	LROPT	TRACE			
				0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED

PLAN= 1 NRTIO= 5 LRTIO= 1
NRTIO= .30 .40 .50 .60 .80 1.00

D-15

SUB-AREA RUNOFF COMPUTATION

INFLOW TO CUMINGS POND

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDRO TUNG TAREA SNAP TRSDA TRSPC RATIO TSROW TSAME LOCAL

1	1	.44	0.00	.44	0.00	0.000	0	1	0
---	---	-----	------	-----	------	-------	---	---	---

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.93	117.00	127.00	136.00	142.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STWRK	DLTKR	RTIOL	ERAIN	STNKS	RTIOK	STRIL	CHSTL	ALSNR	RTIRP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

4/11

UNIT HYDROGRAPH DATA
TP= .78 CP= .62 NTA= 0

RECESSION DATA
STRTO= -1.50 ORCSN= -.05 RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.80 AND R= 2.75 INTERVALS

UNIT HYDROGRAPH 17 END-OF-PERIOD ORDINATES, LAG= .78 HOURS, CP= .62 VOL= 1.00
33. 17. 19. 9. 6. 3. 2. 20.
199. 218. 175. 121. 84. 58. 40. 10.

HYDROGRAPH ROUTING

ROUTE THROUGH CUMINGS POND

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

CLOS	CLOS	AVG	INES	ISAME	IOPT	IPMP	LSTR
0.000	0.000	0.00	1	1	0	0	0

MSPS	MSDOL	LAG	ANSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1191.	-1

STAGE 1191.00 1193.00 1194.00 1195.00 1197.00 1200.00
FLOW 0.00 20.00 45.00 105.00 180.00 285.00 310.00

CAPACITY= 0. 113. 310. 913.

ELEVATION= 1189. 1191. 1195. 1200.

CREL	SPWID	COON	EXPH	ELEV	COOL	CAREA	EXPL
1191.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA
TOPEL COOD EXPD DAMWID
1193.0 3.0 1.5 10.

CREST LENGTH 10. 587. 1250. 1190.
AT OR BELOW
ELEVATION 1193.0 1200.0 1210.0 1220.0

HYDROGRAPH ROUTING

ROUTE THROUGH CHANNEL REACH NO. 1

ISTAQ	ICOMP	IECON	ITAPE	JPLI	JPRI	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0
ROUTING DATA								
CLOSS	CLOSS	AVG	IRIS	ISAME	IOPT	IPMP	LSTR	
0.0	0.000	0.00	1	1	0	0	0	
NSTPS NSTDL LAG ANSKK X TSK STORA ISPRAT								
1	0	0	0.000	0.000	0.000	0.000	0	0

NORMAL DEPTH CHANNEL ROUTING

D-17

ON(1)	ON(2)	ON(3)	ELNVT	ELMAX	RLNTH	SEL
10800	00900	10800	1100.0	1140.0	4280	02200

CROSS SECTION COORDINATES--STA.ELEV,STA.ELEV--ETC

STA	ELEV	STA	ELEV	STA	ELEV
0.00	1140.00	110.00	1120.00	250.00	1100.00
254.00	1098.00	508.00	1120.00	700.00	1140.00

STORAGE	0.00	2.09	8.79	22.12	42.06	68.61	101.75	141.90	187.86
240.81									
1262.29	300.37	368.27	445.94	533.38	630.60	737.59	854.36	980.90	1117.21

OUTFLOW	0.00	119.67	677.35	2042.48	4930.98	8414.02	13937.24	21328.58	30802.56
42583.02									
343028.99	56727.72	72386.65	91562.45	114443.67	141261.15	172260.44	207690.66	247799.75	292832.35

STAGE	1098.00	1100.21	1102.42	1104.63	1106.84	1109.05	1111.26	1113.47	1115.68
1117.89									
1180.00	1120.11	1122.32	1124.53	1126.74	1128.95	1131.16	1133.37	1135.58	1137.79

FLOW	0.00	119.67	677.35	2042.48	4530.98	8414.02	13937.24	21328.58	30802.56
342563.02									
343028.99	56727.72	72386.65	91562.45	114443.67	141261.15	172260.44	207690.66	247799.75	292832.35

6/11

SUB-AREA RUNOFF COMPUTATION

INFLOW FROM SUBAREA NO. 2

ISTAQ	ICOMP	TECON	ITAPE	JPLT	JPR1	INAME	ISTAGE	TAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INYDG	IUNG	TAREA	SNAP	TNSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.97	0.00	.57	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.93	117.00	127.00	136.00	142.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LRPOT	STRES	DLTKR	RTIOL	ERATN	STRES	RTIOL	STREL	CMSTL	ALSMX	RTTRP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP	1.26	CP	.62	MTA	0
----	------	----	-----	-----	---

RECESSION DATA

STRTIO	-1.50	GRCSN	-.05	RTIOR	2.00
--------	-------	-------	------	-------	------

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 6.27 AND R= 5.12 INTERVALS

UNIT HYDROGRAPH-51 END-OF-PERIOD ORDINATES, LAG= 1.33 HOURS, CPT= .62, VOL= 1.00

12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240	252	264	276	288	300	312	324	336	348	360	372	384	396	408	420	432	444	456	468	480	492	504	516	528	540	552	564	576	588	600
12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240	252	264	276	288	300	312	324	336	348	360	372	384	396	408	420	432	444	456	468	480	492	504	516	528	540	552	564	576	588	600
12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240	252	264	276	288	300	312	324	336	348	360	372	384	396	408	420	432	444	456	468	480	492	504	516	528	540	552	564	576	588	600

COMBINE HYDROGRAPHS

COMBINING TWO HYDROGRAPHS

ISTAQ	ICOMP	TECON	ITAPE	JPLT	JPR1	INAME	ISTAGE	TAUTO
5	2	0	0	0	0	1	0	0

40

SUB-AREA RUNOFF COMPUTATION

INFLOW FROM SUBAREA NO. 3

ISTAO 6 ICOMP 0 IECON 0 IIAPE 0 JPLI 0 JPRI 0 INAME 1 I1STAGE 1 I1AUTO 0

HYDROGRAPH DATA

THVDC 1 TUNG 1 TAREA 1.40 SNAP 0.00 TRSDA 0.40 TRSPC 0.00 RATIO 0.000 ISNOW 0 ISAME 1 LOCAL 0

PRECIP DATA

SPFE 0.00 PMS 21.53 R6 117.00 R12 127.00 R24 136.00 R48 142.00 R72 145.00 R96 0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LEOPT 0 STARR 0.00 DLYRN 0.00 RTIOL 1.00 ERAIN 0.00 STRKS 0.00 RYIOK 1.00 STRTL 1.00 CNSTL .05 ALSHX 0.00 RYIMP 0.00

UNIT HYDROGRAPH DATA

TP= 1.54 CP= .62 NTA= 0

RECESSION DATA

SIRIQ= -1.50 ORCSN= -.05 RIIOF= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 7.11 AND R= 5.64 INTERVALS

UNIT HYDROGRAPH 34 END-OF-PERIOD ORDINATES. LAG= 1.054 HOURS. CP= .62 VOL= 1000

6.	23.	46.	70.	91.	103.	105.	95.	80.	67.
56.	47.	39.	33.	28.	23.	19.	16.	15.	11.
2.	9.	8.	7.	6.	4.	3.	3.	2.	2.

SUB-AREA RUNOFF COMPUTATION

INFLOW FROM SUBAREA NO. 4

TSTAQ 7 TCOMP 0 IECON 0 ITAPE 0 JPLT 0 JPRT 0 INAME 1 TSTAGE 0 TAUTO 0

HYDROGRAPH DATA
INYDG 1 IUNG 1 TAREA 1.28 SNAP 0.00 TRSDA 1.28 TRSPC 0.000 RATIO 0.000 ISNOW 0 ISAME 1 LOCAL 0

D-20

PRECIP DATA
SPFE 0.00 PMS 21.53 H6 117.00 N12 127.00 R24 136.00 N48 142.00 N72 145.00 N96 0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT 0 STKR 0.00 DLTR 0.00 HTIOL 1.00 ERAIN 0.00 SINKS 0.00 RTIOK 1.00 STRTL 1.00 CNSTL .05 ALSMX 0.00 RTIMP 0.00

UNIT HYDROGRAPH DATA
TP= 1.00 CP= .62 NTA= 0

RECESSION DATA

STRTQ= -1.50 ORCSN= -.05 RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=8.38 AND R= 6.94 INTERVALS
UNIT HYDROGRAPH 42 END-OF-PERIOD ORDINATES: LAG= 1.87 HOURS, CP= .63 VOL= 1.00
12. 46. 92. 144. 197. 241. 269. 279. 286. 296.
204. 177. 153. 132. 115. 99. 86. 74. 64. 56.
48. 42. 36. 31. 27. 23. 20. 18. 15. 13.
11. 10. 9. 7. 6. 5. 4. 3. 2. 1.

COMBINE HYDROGRAPHS

COMBINING THREE HYDROGRAPHS

9/1

HYDROGRAPH ROUTING

ROUTE THROUGH LAKE LOUISE

ISTAO	ICOMP	IECON	ITAPE	JPLI	JPRT	INAME	ISTAGE	IAUTO
9	1	0	0	0	0	1	0	0

ROUTING DATA

CLOSS	CLOSS	AVG	IRIS	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1093.	-1

STAGE	1093.00	1098.00	1100.00	1101.90	1103.00	1104.00	1105.00	1107.00
341110.00								

FLOW	0.00	250.00	1000.00	1660.00	2380.00	2740.00	3010.00	3340.00	4180.00
5645.00									

CAPACITY= 0. 59. 193. 666. 709. 850.

ELEVATION= 1085. 1090. 1093. 1100. 1101. 1105.

CREL	SPWID	COON	EXPM	ELEV	COOL	CAREA	EXPL
1093.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1101.0	3.0	1.5	95.

CREST LENGTH	5.	39.	75.	105.	135.	190.	233.	260.	285.
AT OR BELOW									

ELEVATION	1101.0	1101.2	1101.5	1101.8	1102.0	1103.0	1104.0	1105.0	1106.0

STATION 9. PLAN 1. RATIO 1

10/1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS					
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	
				.30	.40	.50	.60	1.00	
HYDROGRAPH AT 1									
	1	.44	1	538.	717.	897.	1076.	1793.	
		1.14		15.23	20.31	25.39	30.47	50.78	
ROUTED TO 2									
	2	.44	1	110.	238.	399.	577.	1140.	
		1.14		3.12	6.73	11.29	16.33	32.28	
ROUTED TO 3									
	3	.44	1	109.	237.	398.	576.	1137.	
		1.14		3.10	6.72	11.27	16.28	32.21	
HYDROGRAPH AT 4									
	4	.57	1	529.	706.	882.	1059.	1765.	
		1.48		14.99	19.99	24.99	29.98	49.97	
2 COMBINED									
	5	1.01	1	885.	812.	1145.	1532.	2849.	
		2.62		16.58	22.99	32.43	43.39	80.68	
HYDROGRAPH AT 6									
	6	.40	1	352.	469.	586.	703.	1172.	
		1.04		9.95	13.27	16.59	19.91	33.10	
HYDROGRAPH AT 8									
	8	1.24	1	1018.	1357.	1697.	2036.	3354.	
		3.32		28.83	38.44	48.05	57.66	96.09	
3 COMBINED									
	9	2.69	1	1926.	2614.	3398.	4235.	7340.	
		6.97		54.85	74.01	96.23	119.92	207.85	
ROUTED TO 9									
	9	2.69	1	1170.	1725.	2670.	3740.	7251.	
		6.97		33.12	48.86	75.60	105.92	205.33	

SUMMARY OF DAM SAFETY ANALYSIS

(Cumulative Load)

PLAN 1

INITIAL VALUE 1191.00 SPILLWAY CREST 1191.00 TOP OF DAM 1193.00
STORAGE 1113. 113. 212.
OUTFLOW 0. 0. 65.

RATIO OF PMF	MAXIMUM RESERVOIR W.B.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	1192.48	.48	235.	110.	6.75	43.00	0.00
.50	1194.02	1.02	262.	238.	9.50	42.50	0.00
.50	1194.39	1.39	280.	399.	10.50	42.00	0.00
.60	1194.69	1.69	295.	577.	11.50	41.75	0.00
1.00	1195.26	2.36	392.	1100.	16.00	41.25	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW CFS	MAXIMUM STAGE FT	TIME HOURS
.30	109.	1100.6	43.25
.50	237.	1100.7	42.75
.50	398.	1101.3	42.25
.60	574.	1102.0	41.75
1.00	1197.	1103.2	41.50

D-23

SUMMARY OF DAM SAFETY ANALYSIS

(Lake, Abuse Dam)

PLAN 1

INITIAL VALUE 1093.00 SPILLWAY CREST 1093.00 TOP OF DAM 1101.00
STORAGE 193. 193. 105.
OUTFLOW 0. 0. 2039.

RATIO OF PMF	MAXIMUM RESERVOIR W.B.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	1098.21	0.00	566.	1170.	0.00	43.25	0.00
.40	1100.17	0.00	675.	1725.	0.00	43.25	0.00
.50	1102.10	1.10	745.	2670.	2.25	42.75	0.00
.60	1103.11	2.11	782.	3740.	3.25	42.25	0.00
1.00	1105.08	4.08	853.	7251.	5.25	41.50	0.00

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

1 A1 RATIOS OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSSTREAM
 2 A2 DOWNSSTREAM CONDITION DUE TO OVERTOPPING (LAKE LOUISE)
 3 A3 PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH
 4 B 288 0 15 0 0 0 0 0
 5 B1 5
 6 J 2 1 1
 7 J1 .5

8 K 1
 9 K1 INFLOW TO CUMMINGS POND
 10 M 1 .44
 11 P 21.53 117 127 136 142 145 1.0 .05
 12 T
 13 W .78 .62
 14 X -1.5 -.05 2.0
 15 K 1
 16 K1 ROUTE THROUGH CUMMINGS POND
 17 Y 1

18 V1 1
 19 V4 1191 1192 1193 1194 1195 1197 1200
 20 V5 0 20 65 105 180 385 810
 21 S5 0 113 310 913
 22 SE 1185 1191 1195 1200
 23 S8 1191
 24 S0 1193 3.0 1.5 10
 25 S1 10 587 1350 1190
 26 SV 1193 1200 1210 1220
 27 K 1
 28 K1 ROUTE THROUGH CHANNEL REACH NO. 1
 29 V 1

30 V1 1
 31 V6 .06 .05 .06 1098 1140 4250 .022 1098 259 1098
 32 V7 0 1140 110 1120 250 1100 254 1
 33 V7 263 1100 400 1120 700 1140
 34 K 0
 35 K1 INFLOW FROM SUBAREA NO. 2
 36 M 1 .57
 37 P 21.53 117 127 136 142 145 1.0 .05
 38 T
 39 W 1.36 .62
 40 X -1.5 -.05 2.0
 41 K 2 5
 42 K1 COMBINING TWO HYDROGRAPHS
 43 K 0
 44 K1 INFLOW FROM SUBAREA NO. 3
 45 M 1 1 .40

D-24

46	P	21.53	117	127	136	142	145	.05
47	T						1.0	
48	W	1.54	.62					
49	X	-1.5	-0.5	2.0				
50	K	0	7				1	

51	K1	INFLUX FROM SUBAREA NO. 4						
52	M	1	1.28	127	136	142	145	
53	P	21.23	117				1.0	.05

54	T							
55	W	1.88	.62	2.0				
56	X	-1.5	-0.5					
57	K	1	8				1	

58	K1	COMBINING THREE HYDROGRAPHS						
59	K	1	9				1	
60	K1	ROUTE THROUGH LAKE LOUISE						
61	V							
62	V1	1						
63	V4	1093	1093	1100	1101.9	1103	1104	1107
64	V5	0	250	1000	1660	2740	3010	3340
65	V5	0	58	193	666	705	850	850
66	SE	1083	1090	1093	1100	1101	1105	

D-25

67	SS	1093						
68	SO	1101	3.0	1.5	95			
69	SL	5	35	75	105	135	190	233
70	SV	1101	1101.2	1101.5	1101.8	1102	1103	1106
71	SB	28	.5	1085	2.0	1093	1102	
72	SB	28	.5	1085	2.0	1093	1105	
73	K	1	10					
74	K1	ROUTE DOWNSTREAM REACH 1						
75	V							

76	V1	1						
77	V4	.06	.05	.06	1018	1060	3750	.02
78	V7	0	1060	290	1060	350	1020	354
79	V7	.363	1020	400	1040	480	1060	
80	K	1	11					
81	K1	ROUTE DOWNSTREAM REACH 2						
82	V							
83	V1	1						
84	V6	.06	.05	.06	938	980	3500	.02
85	V7	0	980	100	960	370	940	374
86	V7	.383	940	710	960	890	980	938
87	K	99						

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

NUM DATE# 80/07/18.
 TIME# 13.50.10.

RATIOS OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
 DOWNSTREAM CONDITION DUE TO OVERTOPPING (LAKE LOUISE)
 PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPKT	NSTAN
288	0	15	0	0	0	0	0	0	0

JOB# 5
 LROPT 0
 TRACE 0

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 2 NRATIO= 1 LRTIO= 1

RTIOS= .350

D-26

SUB-AREA RUNOFF COMPUTATION

IMPLOV TO CUMMING'S POND

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

HYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.44	0.00	.44	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PM5	R6	R12	R24	R48	R72	R96
0.00	21.53	117.00	127.00	136.00	142.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STNKR	DLTKN	MTIUL	LHAIN	STNKS	RTIOK	STRTL	CNSTL	ALSNX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
IP= .78 CP= .62, NTA= 0

RECESSION DATA
ORCSN= -0.05 RTION= 2.00
AND H= 2.75 INTERVALS

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNOYER CP AND TP ARE TC = 3.80 AND R = 2.75 INTERVALS
SINTQ = -1.50 URCSN = -.05 RTION = 2.00
END-OF-PERIOD ORIGINATES, LAG = .78 HOURS, CP = .62 VOL = 1.00
28.

	UNIT HYDROGRAPH	17 END-OF-PERIOD ORIGINATES,	LAG=	.78 HOURS,	CP= .62	VOL= 1000	28.
330.	117.	199.	21H.	175.	121.	84.	58.
18.	13.	5.	6.	4.	3.	2.	40.

HYDROGRAPH ROUTING

HYDROGRAPH ROUTING

POWERS THROUGH CUMMINGS POND

JPRT	INAME	ISTAGE	AUTO
0	1	0	0

ALL PLANS HAVE SAME:

ROUTING DATA
RES ISAME 10PT 1PMP LSTR 0

-27

STAGE	NSIPS	INSTOL	LAG	AMSKN	-
1	1192.00	1193.00	1194.00	1195.00	1197.00
	1191.00				1200.00
				120.00	385.00
					810.00

FLOW	0.00	20.00	85.00
105.00			

CAPACITY=	0.	113.	310.	913.

1904	1904
1905	1905
1906	1906
1907	1907
1908	1908
1909	1909
1910	1910
1911	1911
1912	1912
1913	1913
1914	1914
1915	1915
1916	1916
1917	1917
1918	1918
1919	1919
1920	1920
1921	1921
1922	1922
1923	1923
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1989	1989
1990	1990
1991	1991
1992	1992
1993	1993
1994	1994
1995	1995
1996	1996
1997	1997
1998	1998
1999	1999
2000	2000

COOL	ELEV	EXPW	COOW	SPWID	EXPL
0.0	0.0	0.0	0.0	0.0	0.0

TOPEL	COOD	DAM DATA	DAMWID
100	100	100	100

1190.	1350.	587.	10.
-------	-------	------	-----

CREST LENGTH
AT OR BELOW

	1200.0	1210.0	1220.0
1200.0	1210.0	1220.0	

HYDROGRAPH ROUTING

ROUTE THROUGH CHANNEL REACH NO. 1

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME

ROUTING DATA

CLOSS	CLOSS	AVG	IRIS	ISAME	IOPT	IPMP	LSTR
0.00	0.000	0.000	1	1	0	0	0

MSIPS	MSIDL	LAG	ANSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0	0

NORMAL DEPTH CHANNEL ROUTING

OM(1)	OM(2)	ELNVT	ELMAX	RLNTH	SEL
0.000	0.000	1098.0	1140.0	4250	0.2200

CROSS SECTION COORDINATES--STATELEV,STA,ELEV--ETC

STA	ELEV	STA	ELEV
0.00	1140.00	110.00	1098.00
263.00	1100.00	400.00	1120.00
		700.00	1140.00

STORAGE	0.00	2.05	8.79	22.12	42.06	68.61	101.75	141.50	187.86
1240.81									

OUTFLOW	0.00	119.67	677.35	2042.48	4530.98	8414.02	13937.24	21328.58	30802.56
142563.02									

STAGE	1098.00	1100.21	1102.42	1104.63	1106.84	1109.05	1111.26	1113.47	1115.68
1117.89									

STAGE	1098.00	1100.21	1102.42	1104.63	1106.84	1109.05	1111.26	1113.47	1115.68
1117.89									

STAGE	1098.00	1100.21	1102.42	1104.63	1106.84	1109.05	1111.26	1113.47	1115.68
1117.89									

STAGE	1098.00	1100.21	1102.42	1104.63	1106.84	1109.05	1111.26	1113.47	1115.68
1117.89									

STAGE	1098.00	1100.21	1102.42	1104.63	1106.84	1109.05	1111.26	1113.47	1115.68
1117.89									

STAGE	1098.00	1100.21	1102.42	1104.63	1106.84	1109.05	1111.26	1113.47	1115.68
1117.89									

STAGE	1098.00	1100.21	1102.42	1104.63	1106.84	1109.05	1111.26	1113.47	1115.68
1117.89									

SUB-AREA HUNOFF COMPUTATION

INFLOW FROM SUBAREA NO. 2

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INVDG	IUNG	IARLA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.57	0.00	.57	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.53	117.00	127.00	136.00	142.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STKR	DLTK	MTUL	ERAIN	STKKS	RTIOK	STRIL	CNSIL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.36 CP= .62 NTA= 0

RECESSION DATA

STRTO= -1.50 QRCEN= -.05 RTTOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 6.27 AND R= 9.12 INTERVALS

UNIT HYDROGRAPH 31 END-OF-PERIOD ORDINATES LAG= 1.35 HOURS CP= .62 VOL= 1.00

12.	43.	85.	127.	157.	168.	155.	129.	106.	87.
72.	59.	48.	40.	33.	27.	22.	18.	15.	12.
10.	8.	7.	6.	5.	4.	3.	3.	2.	2.

COMBINE HYDROGRAPHS

COMBINING TWO HYDROGRAPHS

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	2	0	0	0	0	1	0	0

SUB-AREA HUNOFF COMPUTATION

INFLOW FROM SUBAREA NO. 3

ISTAG	6	ICOMP	0	IECON	0	ITAPE	0	JPLT	0	JPRI	0	INAME	1	ISTAGE	0	IAUTO	0
-------	---	-------	---	-------	---	-------	---	------	---	------	---	-------	---	--------	---	-------	---

HYDROGRAPH DATA									
IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.40	0.00		.40	0.000	0	1	0
PRECIP DATA						R48	R72	R96	
SPEE						PMS	R6	R12	R24

TRSPC COMPUTED BY THE PROGRAM IS .800				
0.00	21.53	117.00	127.00	136.00
			142.00	145.00
				0.00

LOSS DATA										
LRPT	STNR	DLTK	RTLO	EMRN	STKS	RTIO	STIR	CNST	ALSM	RTIM
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA		
TP	CP	NFA
1.54	.62	0

[illegible]

1

1

SUB-AREA RUNOFF COMPUTATION

INFLOW FROM SUBAREA NO. 4

Downloaded from <http://ajphaphapublications.org/> on 01/01/2017

ISTAQ 7 ICOMP 0 IECON 0 ITAPE 0 JPLT 0 JPRI 0 INAME 1 ISTAGE 0 IAUTO 0

IMYDG 1 IUNG 1 IAKEA 1.28 SNAP 0.00 TRSDA 1.28 TRSPC 0.00 RATIO 0.000 ISNOW 0 ISAME 1 LOCAL 0

SPFE PMS R6 PRECIP DATA R48 R72 R96

TRSPC COMPUTED BY THE PROGRAM IS .800 0.00 21.53 117.00 127.00 136.00 142.00 145.00 0.00

LOSS DATA

LROPT 0 STNR 0.00 DLTN 0.00 RTIOL 1.00 ERAIN 0.00 STKS 0.00 RTIOL 1.00 CNSTL .05 ALSMX 0.00 RTIMP 0.00

UNIT HYDROGRAPH DATA TP= 1.00 CP= 162 RTA= 0

RECESSION DATA

STRIQ= -1.50 ORCSN= -.05 RTIOL= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDEN CP AND TP ARE TC= 3.58 AND R= 6.95 INTERVALS

UNIT HYDROGRAPH 42 END-OF-PERIOD ORDINATES LAG= 1.07 HOURS CP= .63 VOL= 1.00

12.	46.	92.	144.	197.	241.	269.	279.	288.	236.
204.	177.	153.	132.	115.	99.	86.	74.	64.	56.
48.	42.	36.	31.	27.	23.	20.	18.	15.	13.
11.	10.	9.	7.	6.	5.	4.	3.	2.	1.

No

COMBINE HYDROGRAPHS

COMBINING THREE HYDROGRAPHS

ISTAG	ICOMP	IECON	ITAPE	JPL7	JPR1	INAME	ISTAGE	IAUTO
5	3	0	0	0	0	1	0	0

— 總編輯 鄧雲之 謹啟

ROUTE THROUGH LAKE LOUISE

ISTAG	ICOMP	IECON	IYAPE	JPLT	JPRY	TNAME	TSTAGE	TAUTO
9	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME

CLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
D-0	0-000	0-00	I	I	0	0	0

NSIPS	NSTDL	LAG	AMSKK	X	TSK	STURA	ISPRAT
1	0	0	0.000	-	0.000	-1093.	-1

STAGE	1093.00	1095.00	1098.00	1100.00	1101.90	1103.00	1104.00	1105.00	1107.00
	1110.00								

	0.00	250.00	1000.00	1660.00	2380.00	2740.00	3010.00	3340.00	4180.00
FLOW									
	345649.00								

CAPACITY=	01	50.	193.	666.	705.	820.
ELEVATION=	1085.	1090.	1093.	1100.	1101.	1105.

D-3b

IOPEL	DAM DATA		DAMWID
	COORD	EXPD	
1101.0	3.0	1.5	'95.

CREST LENGTH AT OR BELOW ELEVATION	5.	35.	75.	105.	135.	190.	233.	260.	285.
1101.0	1101.0	1101.2	1101.5	1101.8	1102.0	1103.0	1104.0	1105.0	1106.0

BRWID	DAM BREACH DATA				
	Z	FLNM	TFAIL	WSEL	FATLCL
28.	.50	1085.00	2.00	1093.00	1102.00

4/20

STATION 9

TIME (HRS)	(10) INTERPOLATED BREACH HYDROGRAPH (B) COMPUTED BREACH HYDROGRAPH	(11) POINTS AT NORMAL TIME INTERVAL									
2600.	3000.	3200.	3400.	3600.	3800.	4000.	4200.	4400.	4600.	4800.	
345645.0.											
42.50 1.											
345645.0.											
42.54 2.	OB										
345645.0.											
42.58 3.	OB										
345645.0.											
42.63 4.	OB										
345645.0.											
42.67 5.		OB									
345645.0.											
42.71 6.											
345645.0.											
42.75 7.											
345645.0.											
42.79 8.			OB								
345645.0.											
42.83 9.				OB							
345645.0.											
42.88 10.											
.....											
42.92 11.				OB							
.....											
42.96 12.											
.....											
43.00 13.											
.....											
43.04 14.					OB						
.....											
43.08 15.											
.....											
43.13 16.						OB					
.....											
43.17 17.							OB				
.....											
43.21 18.											
.....											
43.25 19.											
.....											
43.29 20.											
.....											
43.33 21.											
.....											

43.38 22. OB

 43.42 23. OB.

 43.46 24. W

 43.50 25. W

 43.54 26. BO

 43.58 27. BO

 43.62 28. BO.

 43.67 29. BO

 43.71 30.B.....

43.75 31.

 43.79 32. OB

 43.83 33. OB

 43.88 34.

 43.92 35.

 43.96 36. OB

 44.00 37.

 44.04 38.

 44.08 39.

 44.13 40.B.....

 44.17 41.

 44.21 42.

 44.25 43.

 44.29 44.

 44.33 45.

 44.38 46.

 44.42 47.

 44.46 48.

 44.50 49.

 44.54 50.

 44.58 51.

 44.62 52.

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 44.70 54.

 44.74 55.

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[illegible]

DAM BREACH DATA

BRWID	Z	ECRM	TFAIL	WSEL	FATLCL
28.	.50	1085.00	2.00	1093.00	1105.00

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p-36

1. The first part of the document is a list of names and their corresponding addresses. The names are listed in the left column, and the addresses are listed in the right column. The names are: John Doe, Jane Smith, and Bob Johnson. The addresses are: 123 Main St, 456 Elm St, and 789 Oak St.

2. The second part of the document is a table with two columns: Name and Address. The names are listed in the left column, and the addresses are listed in the right column. The names are: John Doe, Jane Smith, and Bob Johnson. The addresses are: 123 Main St, 456 Elm St, and 789 Oak St.

3. The third part of the document is a list of names and their corresponding addresses. The names are listed in the left column, and the addresses are listed in the right column. The names are: John Doe, Jane Smith, and Bob Johnson. The addresses are: 123 Main St, 456 Elm St, and 789 Oak St.

1. The first part of the document is a title page. It contains the title of the report, the author's name, and the date of the report. The title is "The Effect of the New Tax Law on the Investment Industry". The author is "John Doe". The date is "January 1, 1980".

2. The second part of the document is an executive summary. It provides a brief overview of the findings of the report. The summary states that the new tax law has had a significant impact on the investment industry, particularly in the area of capital gains. It also mentions that the report includes a detailed analysis of the data and a discussion of the implications of the findings.

3. The third part of the document is the main body of the report. It contains the following sections:

- a. Introduction: This section introduces the topic of the report and provides a brief overview of the research methodology used.
- b. Data Collection: This section describes the sources of the data used in the report and the methods used to collect and analyze the data.
- c. Results: This section presents the findings of the report, including a detailed analysis of the data and a discussion of the implications of the findings.
- d. Conclusion: This section summarizes the main findings of the report and provides a final conclusion.

4. The fourth part of the document is a bibliography. It lists the sources of the data and the references used in the report.

5. The fifth part of the document is an appendix. It contains additional information that is not included in the main body of the report, such as raw data and detailed calculations.

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14/10

HYDROGRAPH ROUTING

ROUTE DOWNSTREAM REACH 1

ISTAU	ICOMP	IECON	ITAPE	JPLY	JPRT	INAME	ISTAGE	IAUTO
10	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME

ROUTING DATA				LSTR			
CLOSS	CLOSS	AVG	TRES	TSAME	TOPT	IPMP	
0.0	0.000	0.00	1	1	0	0	

WSTPS	WSTDL	LAG	AMSK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QRT1	QRT2	ELWUT	ELMAX	RLNTH	SEL
0.000	0.0500	0.0600	1018.0	1060.0	3750. .02000

CROSS SECTION COORDINATES--STA.ELEV.STAELEV--ETC

0.00	1080.00	290.00	1040.00	350.00	1020.00	350.00	1018.00	350.00	1018.00
363.00	1020.00	400.00	1040.00	480.00	1060.00				

STORAGE	1188.43	108.44	132.64	166.62	207.31	255.92	312.24	376.35	448.23	527.91	70.46
	0.00	1379	548	1121	18.98	28.79	60.84	94.34			

OUTFLOW	18383.25	23741.47	28282.46	35209.37	44452.35	56169.34	70579.37	87917.95	108422.46	132326.96
	0.00	112.94	538.74	1343.47	2610.48	4415.57	6829.72	9920.12	13750.82	

STAGE	1037.89	1040.11	1042.32	1044.53	1046.74	1048.95	1051.16	1053.37	1055.56	1057.79
	1018.00	1020.21	1022.42	1024.63	1026.84	1029.05	1031.26	1033.47	1035.68	

FLOW	118383.25	23741.47	28282.46	35209.37	44452.35	56169.34	70579.37	87917.95	108422.46	132326.96
	0.00	113.94	538.74	1343.47	2610.48	4415.57	6829.72	9920.12	13750.82	

STAGE	1037.89	1040.11	1042.32	1044.53	1046.74	1048.95	1051.16	1053.37	1055.56	1057.79
	1018.00	1020.21	1022.42	1024.63	1026.84	1029.05	1031.26	1033.47	1035.68	

FLOW	118383.25	23741.47	28282.46	35209.37	44452.35	56169.34	70579.37	87917.95	108422.46	132326.96
	0.00	113.94	538.74	1343.47	2610.48	4415.57	6829.72	9920.12	13750.82	

[illegible]

HYDROGRAPH ROUTING

ROUTE DOWNSTREAM REACH 2

ISTAG	ICOMP	IRECON	ITAPE	JPLT	JPRY	INAME	ISTAGE	TAOTO
11	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME

QLOSS	CLOSS	AVG	IRCS	ISAME	IOPT	JIMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

INSTPS	INSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

ON(1)	ON(2)	ON(3)	ELNVT	ELMAX	RUNTH	SEL
0000	00500	00600	930.0	980.0	3500.	002000

CROSS SECTION COORDINATES--STA., ELEV., STA., ELEV.--ETC.

[illegible]

OUTFLOW

179478.69	107404.89	144058.75	185749.50	232502.60	284366.29	341404.53	403692.42	471313.07	544355.52
622913.13	938.00	940.21	942.32	944.63	946.84	949.05	951.26	953.47	955.68
STAGE									
1957.89	960.11	962.32	964.53	966.74	968.95	971.16	973.37	975.58	977.79
1980.00									
FLOW	0.00	114.38	833.66	3005.68	7315.71	14342.33	24605.76	38586.41	56734.97
679478.59	107404.89	144058.75	185749.50	232502.60	284366.29	341404.53	403692.42	471313.07	544355.52
622913.13									

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILLS (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION STATION AREA PLAN RATIO 1
 .50

HYDROGRAPH AT 1 .44 1 897.
 (1.14) (25.39)(
 2 897.
 (25.39)(

ROUTED TO 2 .44 1 399.
 (1.14) (11.29)(
 2 399.
 (11.29)(

ROUTED TO 3 .44 1 398.
 (1.14) (11.27)(
 2 398.
 (11.27)(

HYDROGRAPH AT 4 .57 1 882.
 (1.48) (24.99)(
 2 882.
 (24.99)(

2 COMBINED 5 1.01 1 1145.
 (2.62) (32.43)(
 2 1145.
 (32.43)(

HYDROGRAPH AT 6 .40 1 586.
 (1.04) (16.59)(
 2 586.
 (16.59)(

HYDROGRAPH AT 7 1.28 1 1697.
 (3.32) (48.05)(
 2 1697.
 (48.05)(

3 COMBINED 8 2.69 1 3398.
 (6.97) (96.23)(

11/6

ROUTED TO 9 2.69 1 4779.
1 6.971 1 135.321
2 2670.
1 75.601
ROUTED TO 10 2.69 1 4719
1 6.971 1 135.631

ROUTED TO 11 2.69 1 4626.
1 6.971 1 130.981
2 2652.
1 75.111

410

SUMMARY OF DAM SAFETY ANALYSIS

(Cummings Pond)

PLAN 1

ELEVATION
STORAGE
OUTFLOW

INITIAL VALUE SPILLWAY CREST TOP OF DAM
1191.00 1191.00 1193.00
113. 113. 212.
0. 0. 65.

RATIO
OF
PMF

MAXIMUM
RESERVOIR
W.S.ELEV
OVER DAM

MAXIMUM
STORAGE
AC-FT

MAXIMUM
OUTFLOW
CFS

DURATION
OVER TOP
HOURS

TIME OF
MAX OUTFLOW
HOURS

TIME OF
FAILURE
HOURS

.50

1194.39

1.89

280.

399.

10.50

42.00

0.00

PLAN 2

ELEVATION
STORAGE
OUTFLOW

INITIAL VALUE SPILLWAY CREST TOP OF DAM
1191.00 1191.00 1193.00
113. 113. 212.
0. 0. 65.

RATIO
OF
PMF

MAXIMUM
RESERVOIR
W.S.ELEV
OVER DAM

MAXIMUM
STORAGE
AC-FT

MAXIMUM
OUTFLOW
CFS

DURATION
OVER TOP
HOURS

TIME OF
MAX OUTFLOW
HOURS

TIME OF
FAILURE
HOURS

.50

1194.39

1.39

280.

399.

10.50

42.00

0.00

D-41

PLAN 1 STATION 3

MAXIMUM MAXIMUM
FLOW.CFS STAGE.FT

TIME
HOURS

.50 398. 1101.3 42.25

PLAN 2 STATION 3

MAXIMUM MAXIMUM
FLOW.CFS STAGE.FT

TIME
HOURS

.50 398. 1101.3 42.25

44/4

↑	.50	4626.	945.5	44.50
PLAN 2 STATION 11				

RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS
.50	2652.	945.3	43.00

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D-43

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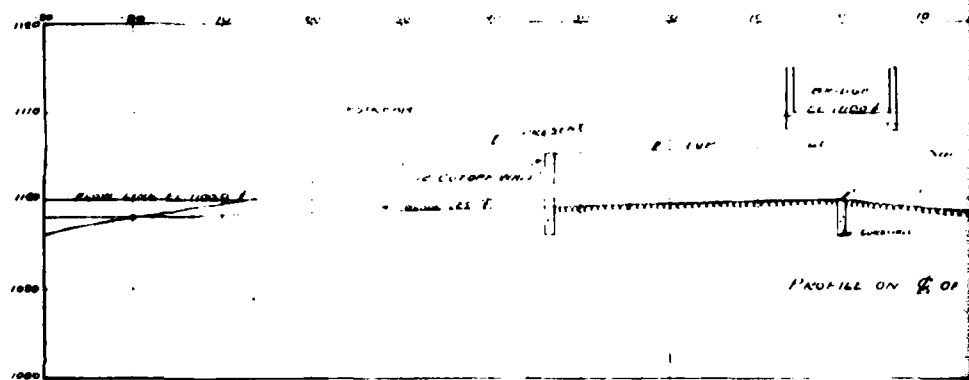
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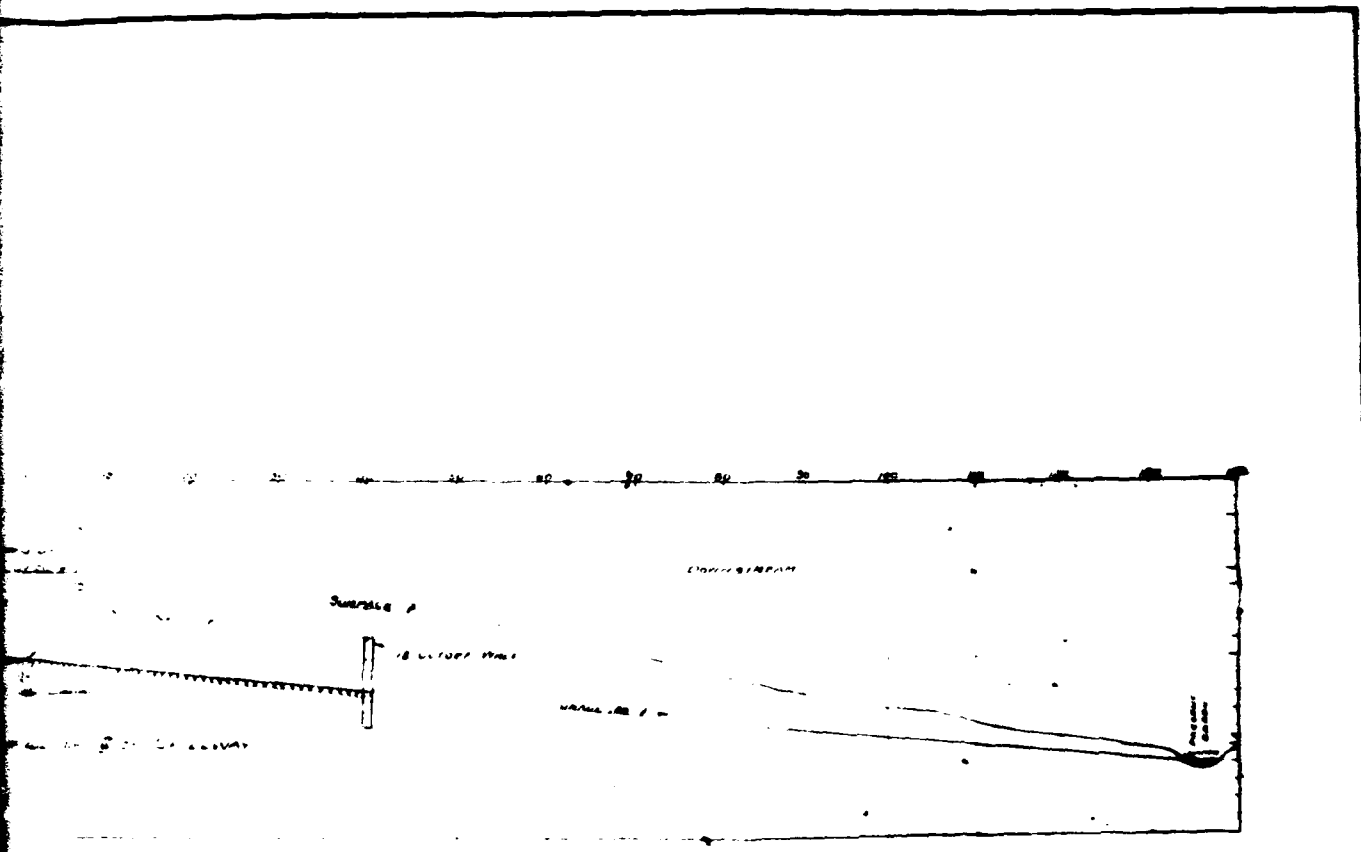
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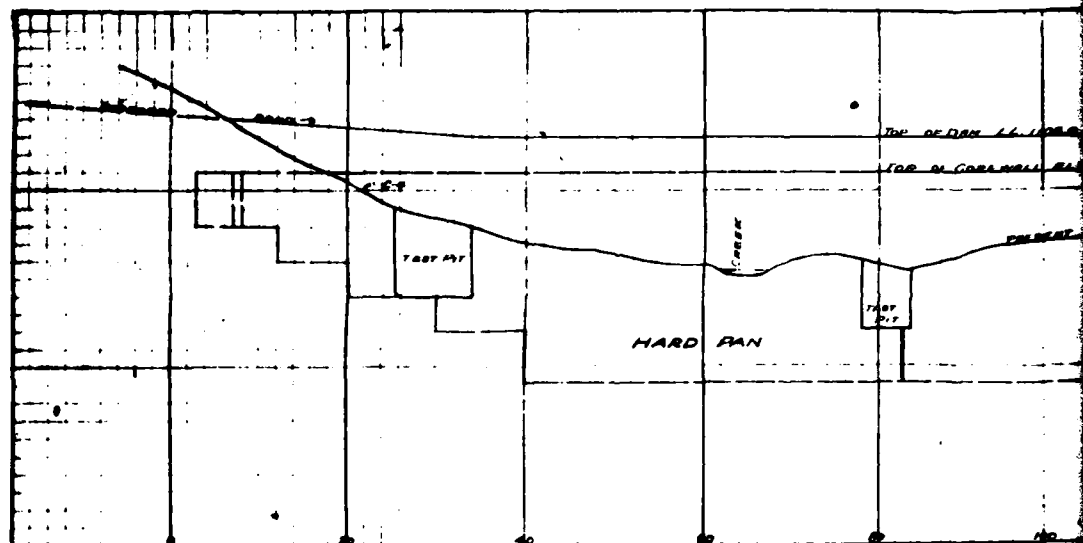
APPENDIX E
DRAWINGS



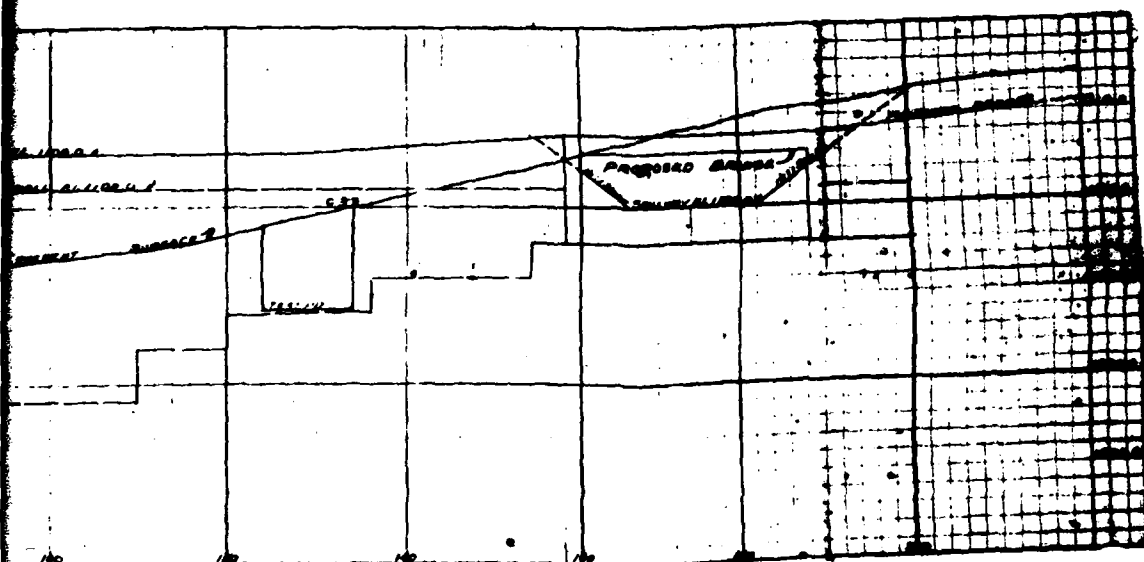
405
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1/1/1



UPPER END OF RAILWAY
 PROPOSED DAM
 L. ROBERT KIMBALL & ASSOCIATES
 CONSULTING ENGINEERS & ARCHITECTS
 1000 P STREET, N.W.
 WASHINGTON, D.C.



LONG
GOERING
FRANKLIN
SCALE 1:1000



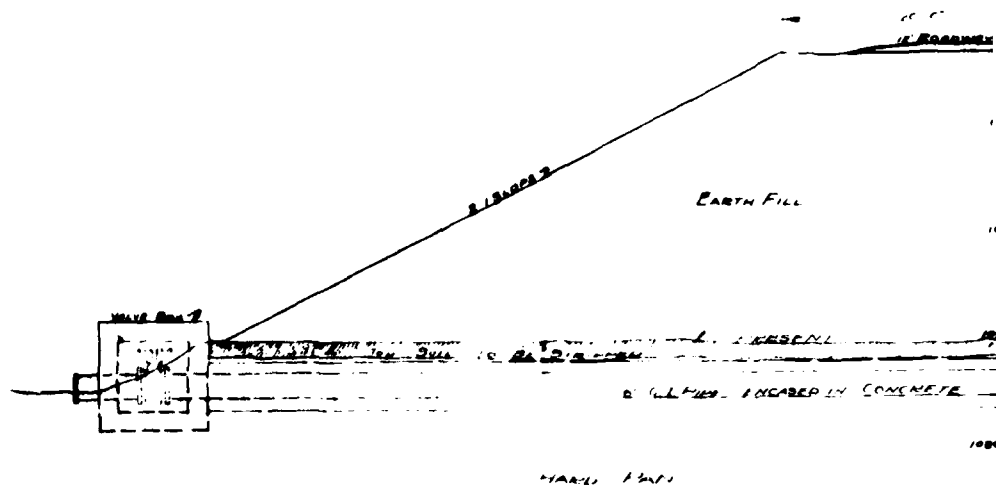
LONGITUDINAL SECTION
PROPOSED DAM

RINGER & HOFFMAN FARM

NALIN TWR LUTHERNE CO., PA.
OCTOBER 1925. *H. W. Kimball, Eng.*
WILKES BARRE, PA.

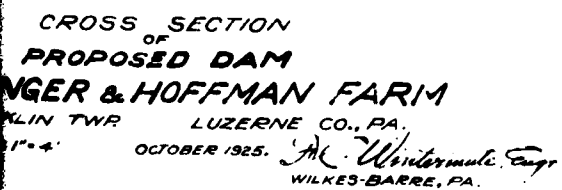
E-3

L. Robert Kimball
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS



ESTIMATED QUANTITIES
 600 CY. TRENCH EXCAVATION
 1000 - - GRILLAGE
 500 - - FILL
 500 - - CONCRETE 1:2:4
 1000 - - ROAD SURFACE
 500 - - SUB GRP
 500 - - STRIPPING
 100 LBS. 12\"/>

CROSS
 PROP
 GOERINGER &
 FRANKLIN TWP
 SCALE: 1" = 4'



L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

AD-A091 448

KIMBALL (L ROBERT) AND ASSOCIATES EBENSBURG PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM, LAKE LOUISE DAM (NDS ID NUMBER--ETC(U)
SEP 80 R J KIMBALL DACW31-80-C-0020

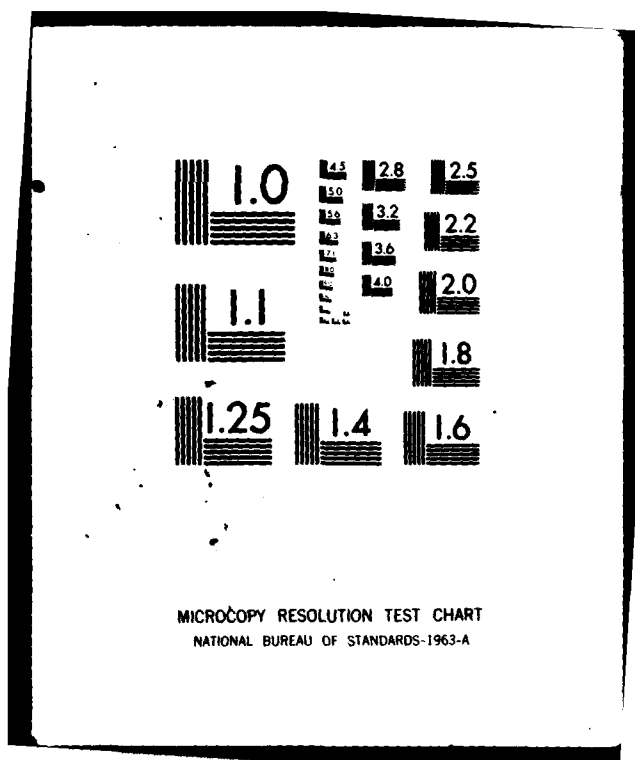
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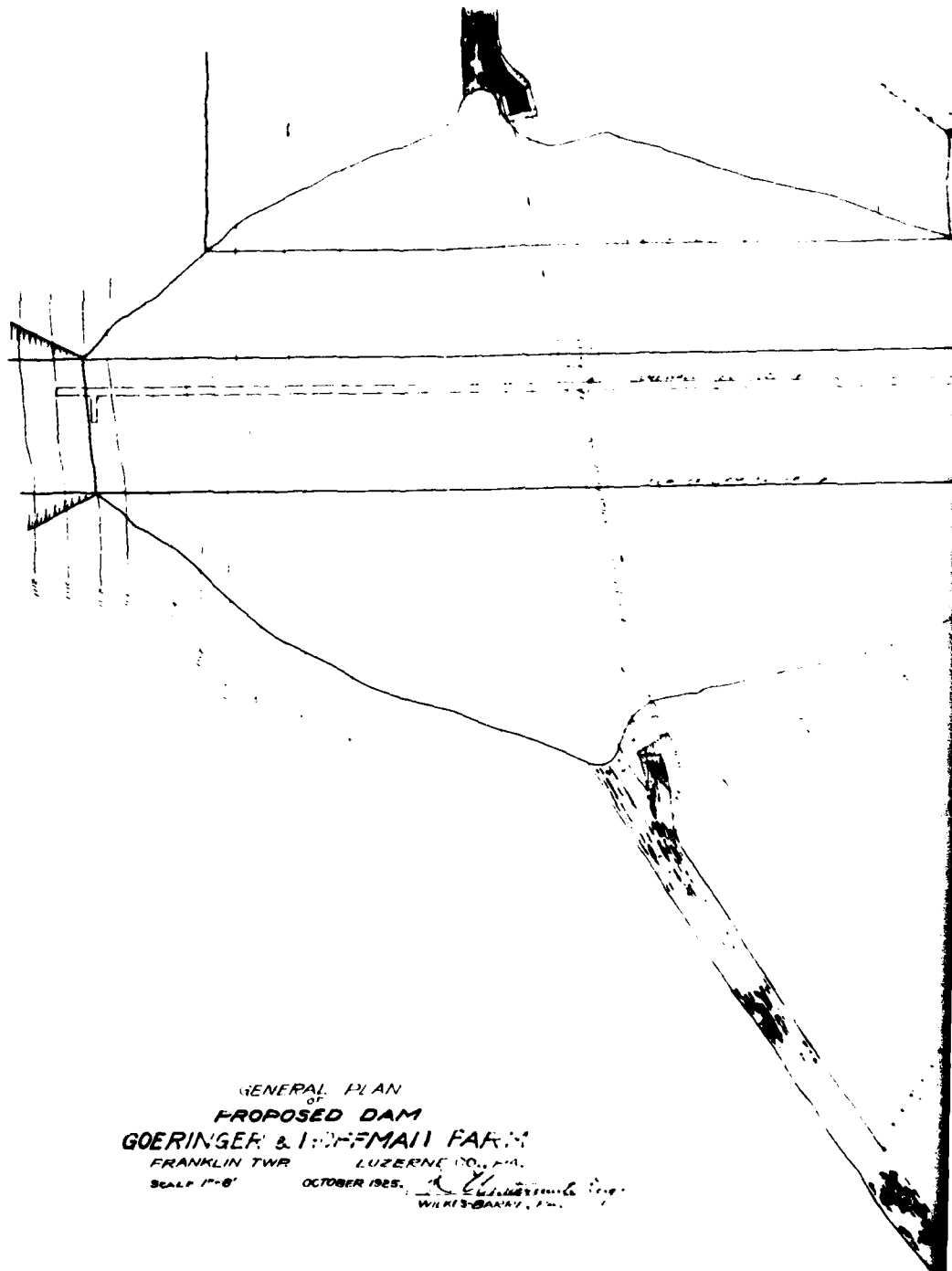
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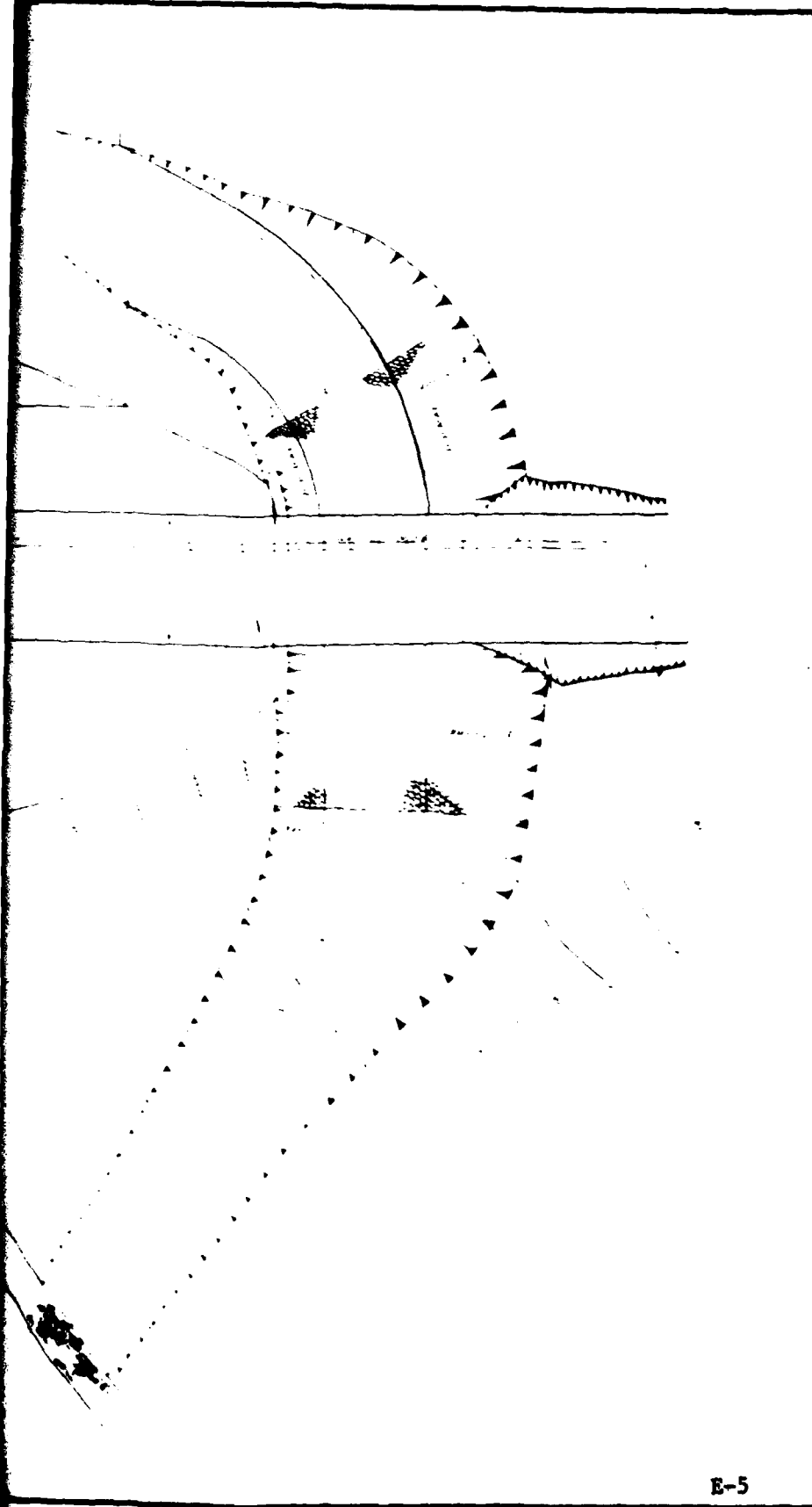
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GENERAL PLAN
OF
PROPOSED DAM
GOERINGER & LUDFMAN FARM
FRANKLIN TWP LUZERNE CO., PA.
SCALE 1"=8' OCTOBER 1925.

WILKES-BARRY, PA.



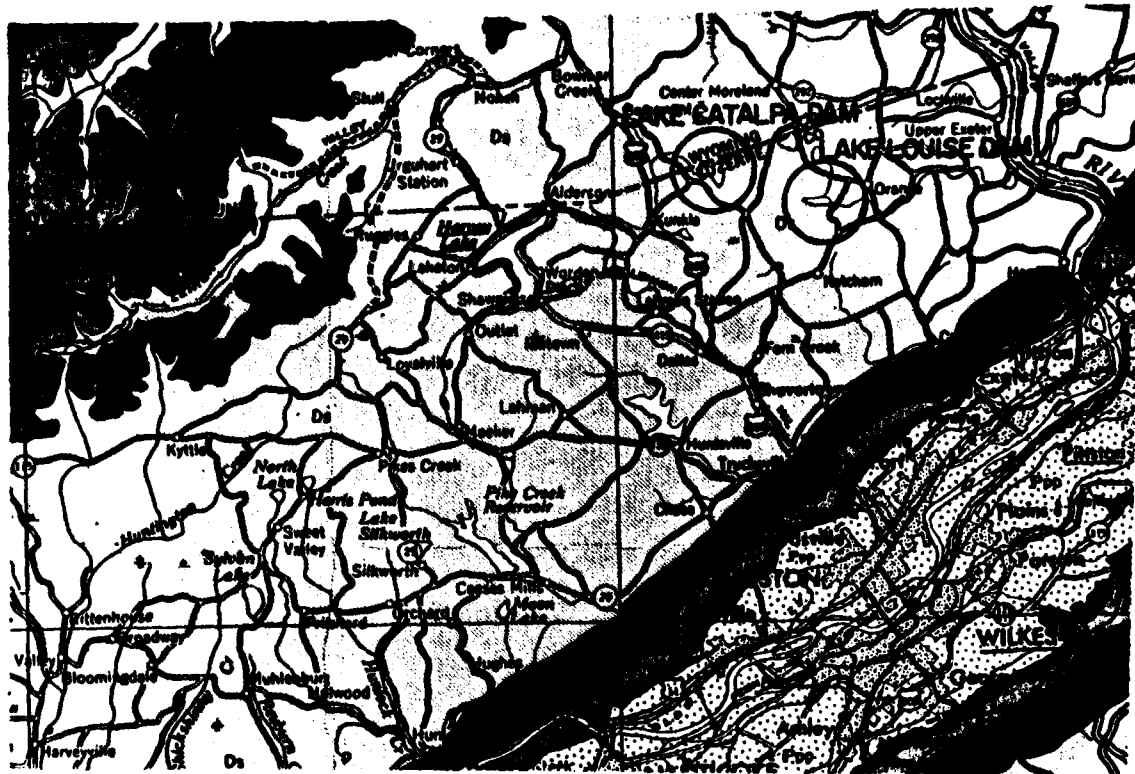
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

APPENDIX F
GEOLOGY

General geology

Lake Louise and its dam lie within the (Glaciated) Low Plateaus Section of the Appalachian Plateaus Physiographic Province. This area is characterized by broad anticlines and synclines and little, if any, faulting. There are no known faults in the vicinity of the dam.

The rocks underlying the lake and dam consist of the Devonian aged Susquehanna Group. This is a complex unit of conglomerate, sandstone, siltstone and shale. The usually well developed bedding ranges in thickness from less than one to over fifteen feet. The well developed joints are regular and closely spaced in the shales and siltstones. They are vertical or steeply dipping and usually form a blocky or platy pattern. The shales disintegrate rapidly, but the siltstone, sandstone and conglomerate are fairly resistant to weathering. The rocks of the Susquehanna Group form a good foundation for heavy structures if excavated to sound material and the shales and siltstones are kept water free. The interstitial porosity of the coarser rocks is low, but joint development has created a medium level effective porosity.



GEOLOGIC MAP OF THE AREA AROUND LAKE CATALPA DAM AND LAKE LOUISE DAM



Onaway Formation

Brownish and greenish gray, fine and medium grained sandstones with some shales and scattered calcareous lenses; includes red shales which become more numerous eastward. Relation to type Onaway not proved.



Catskill Formation

Chiefly red to brownish shales and sandstones; includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.



Marine beds

Gray to olive brown shales, graywackes, and sandstones; contains "Chemung" beds and "Portage" beds including Burkei, Brallier, Harrell, and Trimmers Rock; Tully Limestone at base.



Susquehanna Group

Barbed line is "Chemung-Catskill" contact of Second Pennsylvania Survey County reports; barbs on "Chemung" side of line.

SCALE 1:250,000